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ABSTRACT

This proceedings contains summaries of sessions on topics related to the use of computing across a wide range of disciplines and levels of education, including curriculum and instructional strategies, current and emerging technologies, social and ethical issues, library/media, technology implementation, exhibitors, teacher education and training, staff development, computer science, distance learning, using technology to facilitate learning, and laptops. The following research papers are included: "Using Higher Order Computer Tasks with Disadvantaged Students" (Neil Anderson); "Simulations for Lifelong Learning" (Gina Cherry, et al.); "A League of Their Own: Gender, Technology, and Instructional Practices" (Dorothy Valcarcel Craig); "BEN:LINCS: A Community Model for the Pennsylvania Education Network" (Scott Garrigan); "Difficulties Bring Wisdom: Online Learners Learn How Online Communities Learn" (Lisa Herman, et al.); "A Computer Game To Teach Programming" (Ken Kahn); "Parent-Completed Screening Test for Developmentally At-Risk Young Children" (Sang Seok Nam); "Web-Based Instruction: Business Courses" (Kwi Park-Kim); "Are Academic Behaviors Fostered in Web-Based Environments?" (Mary Jo Parker); "A Self-Fulfilling Prophecy: Online Distance Learning for Introductory Computing" (Kris Powers); "Students Learning Mathematics through Computer-Aided Presentations" (Lawrence Sher and Patricia Wilkinson); "Infusing Technology into a Teacher Education Course: Elementary Teachers' Mathematical Conceptions" (Maria Timmerman); "Equity: Ownership by Minorities and Women of Research Projects" (Patricia Wilkinson and Lawrence Sher). Descriptions of NECA (National Educational Computing Association) member societies are also included. (AEF)

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necc '99

SPOTLIGHT ON THE FUTURE
technology for the new millennium
atlantic city, nj
national educational computing conference
20 years/1979-99

June 22–24, 1999

Hosted by
ATLANTIC CAPE COMMUNITY COLLEGE

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Introduction

This volume of Proceedings of the Twentieth National Educational Computing Conference (NECC '99) reports on the presentations, innovations, trends, and research in the use of computing across a wide range of disciplines and levels of education. Consistent with the conference theme, Spotlight on the Future, the Proceedings reflect the current breadth of computing in education and provide a benchmark for a vision of this field in the new millennium. These Proceedings are intended to serve as a valuable reference to the important and exciting ideas shared at NECC '99.

Through the general sessions, paper sessions, traditional and Internet poster sessions, workshops, and informal networking, NECC '99 provides participants with the opportunity to share information on the current status and future role of educational computing. The conference and these Proceedings are the result of the diligence, expertise, and commitment of many individuals and groups.

It is our hope that, on this special occasion of NECC's twentieth anniversary conference, NECC '99 will indeed serve as a "Spotlight on the Future" of computing in education for all those who attended the conference or who will have access to these Proceedings.

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NECA Member Societies—1999

These descriptions are provided for the 14 professional societies/associations that belong to the National Educational Computing Association (NECA). Contact information for each society's NECA representative is given following the society's description. Information about each society can also be found via the NECA Web site (http://www.neccsite.org).

AAHE—American Association for Higher Education

AAHE is a membership association of individuals interested in improving the effectiveness of the higher education enterprise as a whole and their own effectiveness in their particular setting. The Association's membership includes more than 8,000 administrators, faculty, and students from all sectors, as well as policy makers and leaders from foundations, business, and government.

AAHE is higher education's citizen's organization, where individuals step beyond their special roles to collectively address the challenges higher education faces. Members share two convictions: that higher education should play a more central role in national life, and that each of our institutions can be more effective. AAHE helps members translate these convictions into action.

Through conferences, publications, and special-interest projects, members acquire both the "big picture" and the practical tools needed to increase their effectiveness in their own setting and to improve the enterprise as a whole.

Contact: Louis Albert, AAHE, 1 Dupont Circle, Suite 360, Washington, DC 20036-1110, aahela@gwuvm.gwu.edu

SIGCAS—ACM Special Interest Group on Computers and Society

With a membership of approximately 1,000, this professional group seeks to identify social and ethical issues raised by computer technology and provide a forum for examining these issues. SIGCAS was one of the sponsors of the ACM Policy98 Conference held in Washington, DC, which brought together computer professionals and government policymakers to discuss the critical technology issues that impact social policy.

SIGCAS publishes a quarterly newsletter, *Computers and Society*, which is a primary source of material on this topic. As a vehicle of communication for the SIGCAS membership, the newsletter includes news, comments, and articles on societal issues raised by computing technology. One of the few periodicals on this subject, it provides a flexible and timely forum for important, evolving topics, such as privacy, equity of access, de-skilling of the workplace, regulation of the Internet, and intellectual property rights. There are also monthly educational columns that include ethics scenarios and case studies, pedagogical ideas, and reviews of new textbooks in the area of ethics and social impact that are useful for high school, community college, and university educators.

According to a recent membership survey, about 40% of SIGCAS members teach course material on computers and society. In recent years, SIGCAS has organized sessions at computer conferences on new methods for teaching the ethical and social impact of computers.

Contact: C. Dianne Martin, EECS Department, George Washington University, 6th Floor, Academic Center, Washington, DC 20052, diannem@seas.gwu.edu

SIGCSE—ACM Special Interest Group on Computer Science Education

SIGCSE became a special interest group of ACM in 1970. It currently consists of more than 2,000 members from educational, industrial, and governmental communities interested in various aspects of computer science education. SIGCSE has goals of encouraging and assisting in the development of effective academic programs and courses in computer science, and promoting research in computer science education.

The following are objectives of SIGCSE:

1. To provide a continuing forum for discussion of common problems among education and other computer scientists through organized meetings and symposia.
2. To publish a bulletin at least quarterly containing information aimed specifically at those interested in computer science education.
3. To work closely with the Education Board of ACM to ensure implementation of effective education programs by the association.

Contact: Harriet Taylor, Computer Science Department, Louisiana State University, Baton Rouge, LA 70803-4020, taylor@bit.csc.lsu.edu

SIGCUE—ACM Special Interest Group on Computer Uses in Education

SIGCUE provides a forum for the discussion of ideas, methods, and policies related to all aspects of computers in the educational process. Established in 1969, its membership (more than 1,400 persons) comes from many countries and numerous, diverse institutions and businesses.

SIGCUE publishes a newsletter, *SIGCUE Outlook*. Recent topics have included preservice education in educational computing, international reports on educational computing, and a teacher training curriculum project. SIGCUE also sponsors and organizes technical sessions at ACM annual meetings, the National Educational Computing Conference, and other national and regional meetings of interest to its members.

Among SIGCUE's goals are:

1. Helping to bring the technical expertise within ACM to bear upon educational computing generally.
2. Cooperating with other special interest groups or educational societies to promote attention to educational computing issues.

3. Providing written and verbal forums for members and the educational community to exchange ideas concerning computer uses in education.

Contact: Karen Gould, Metro School District of Wayne Township, 1220 S. High School Drive, Indianapolis, IN 46241

SIGUCCS—ACM Special Interest Group on University and College Computing Services

SIGUCCS provides a forum for those involved in providing computing services on a college or university campus. The topics addressed by SIGUCCS include managing campus computing, computing as it relates to the overall goals of the institution, and the state of the art in various types of college and university computing services. SIGUCCS provides opportunities to discuss and share ideas and experiences with others.

Two annual conferences are regular activities of SIGUCCS. The Computing Center Management Symposium addresses the many aspects of managing computing on campus. This includes hardware, software, planning, finances, and personnel, to name few. The User Services Conference covers more directly the delivery of particular services to the higher education community. Tutorials on relevant issues are held at both conferences.

In other projects, SIGUCCS offers a peer review of the university computing function. Upon request of the computer center director, members of SIGUCCS will formally analyze and comment on different areas of the campus computing function. SIGUCCS also publishes a quarterly newsletter. We consider the newsletter our most important form of communication because it reaches all members and is subscribed to by numerous university computing centers. Conference proceedings are published either as separate documents or as part of the newsletter itself.

Contact: Chuck Chulvick, Raritan Valley Community College, Box 3300, Somerville, NJ 08876, 908.526.1200 ext. 8409, cchulvic@rvcc.raritanval.edu

AECT—Association for Educational Communications and Technology

The Association for Educational Communications and Technology (AECT) is an international professional association dedicated to the improvement of instruction at all levels through the appropriate use of instructional technology. Founded in 1923, AECT has evolved as an organization as the technology used in education has evolved, from the early use of traditional audiovisual media to today's interactive and multimedia technology platforms. AECT members can be found at all levels of public and private education, from elementary schools to colleges and universities, as well as in the corporate and government sectors.

Organizationally, AECT has nine special interest divisions, eight chapters, 46 state affiliate organizations, and 14 national and international affiliate organizations. With more than 5,000 members, AECT is the largest international association for professionals involved in the integration of instructional technology into the learning process. AECT is the United States representative to the International Council for Educational Media.

Tech Trends, in its 38th year of publication, is the association's professional periodical. Published during the school year, *Tech Trends* features authoritative, practical articles about technology and its integration into the learning environment. *Educational Technology Research and Development*, the association's research quarterly, in its 40th year of publication, is the only refereed journal focusing entirely on research and instructional development in the rapidly changing field of educational technology.

AECT also publishes reference books on a variety of topics, including practical applications of technology, research, copyright, and standards and guidelines for the field of special interest to instructional technologists.

The AECT national convention and exposition is held each year in January or February, drawing more than 12,000 participants and exhibitors. Additionally, AECT sponsors an annual professional development seminar focusing on emerging technologies, and a leadership development conference for leaders within AECT and its affiliates.

Contact: Stanley Zenor, AECT, 1025 Vermont Avenue, NW, Suite 820, Washington, DC 20005, 202.347.7834

CCSC—Consortium for Computing in Small Colleges

CCSC is a nonprofit organization focused on promoting effective use of computing in smaller institutions of higher education that are typically nonresearch in orientation. It supports activities that assist faculty in such institutions to make appropriate judgments concerning computing resources and educational applications of computer technology.

Because departments in smaller colleges and universities are usually small and not highly specialized, the consortium encourages the sharing of expertise, effective curriculum patterns, and efficient technological applications. The consortium is concerned with the advancement of major programs in both computer science and computer information systems, and with the use of computers in the liberal arts and sciences.

The Journal of Computing in Small Colleges is distributed to faculty at more than 400 colleges across the country. Now in its seventh volume, its five annual issues are averaging 500 pages, with articles addressing the broad spectrum of curriculum and computer use in higher education.

Contact: Gail Miles, Lenoir-Rhyne College, Box 7482, Hickory, NC 28603

CoSN—Consortium for School Networking

The Consortium for School Networking is a nonprofit organization formed to further the development and use of telecommunications in K-12 education. CoSN provides a dynamic forum for educational, institutional, and corporate organizations who share the goal of promoting state-of-the-art computer networking technology in schools. By working together through CoSN, these separate groups form a powerful national voice focused on realizing the promise of K-12 networking.

CoSN has identified three areas of work key to fulfilling its mission:

1. Leadership enhancement geared for those at the national, state, and local levels to ensure that information technology has a direct and positive impact on student learning
2. Advocacy at the federal level to ensure that the interests of all students are served by law and policy
3. Coalition building designed to foster partnerships and collaboration leading to improved access, equity, and performance of networking technology

CoSN's activities for accomplishing this work are many. Its Annual K-12 Networking Conference has become the premier forum on telecommunications in the classroom by bringing together key players from national, state and local education, corporations, and government to focus on the most important current issues in K-12 networking. Electronic newsletters and member alerts give up-to-the-minute announcements on K-12 networking issues with specific Legislative Updates from legislative consultant Leslie Harris. CoSN's award-winning Web site at www.cosn.org offers educators a one-stop resource for information on K-12 networking trends and developments. COSNDISC, a moderated online discussion open to everyone on the Internet, serves as a meeting place for everyone interested in school networking.

Contact: Toni Miller, Membership Director, 202.466.6296, ext. 15, infor@cosn.org.

EDUCAUSE—Transforming Education Through Information Technologies

The mission of EDUCAUSE is to help shape and enable transformational change in higher education through the introduction, use, and management of information resources and technologies in teaching, learning, scholarship, research, and institutional management.

The incorporation of EDUCAUSE in 1998 was the result of a consolidation of two prominent educational technology associations—CAUSE and Educom—that recognized an increasing convergence in their missions and goals. The association's focus encompasses the management and use of instructional, research, administrative, and library computing, telecommunications and networking, and administration of this enterprise.

Today, librarians, faculty, presidents, deans, registrars, business officers—most of the campus community—use technology-based information resources and are concerned with using them more effectively and efficiently. The professionals who plan for and manage such resources are challenged to fully leverage the significant investment their campuses have made in them, supporting the growing information needs of staff, faculty, and students, while positioning their institutions for the future. EDUCAUSE provides the leadership, information, professional development, and services our members need to achieve this end.

Membership in EDUCAUSE is open to institutions of higher education, corporations serving the higher education information technology market, and other related associations and organizations. EDUCAUSE provides benefits to both the institutions/organizations and their individual representatives who participate in our activities and use our programs and services, including: professional development opportunities, publications, strategic policy initiatives, and information services.

Contact: EDUCAUSE, 303.449.4430, info@educause.edu, http://www.educause.edu/.

IEEE—Computer Society

The Computer Society is the world's largest association of computing professionals, with a total membership of approximately 108,000 computer scientists, computer engineers, and interested professionals. Society membership is open to IEEE members, associate members, student members, and to non-IEEE members who qualify for affiliate membership. An affiliate member is a person who has achieved status in his or her chosen field of specialization and whose interests focus in the computing field.

Every Computer Society member receives *Computer*, a peer-reviewed monthly magazine of general interest to computing professionals that also covers society news and events. Nine specialized magazines and eight transactions are also available to society members as optional subscriptions, and to nonmembers, libraries, and organizations.

Magazines published by the Computer Society include *IEEE Computer Graphics and Applications, IEEE Micro, IEEE Design and Test, IEEE Software, IEEE Expert, IEEE Annals of the History of Computing, IEEE Multimedia*, and *IEEE Parallel Distributed Technology*. Research-oriented transactions include *IEEE Transactions on Computers, IEEE Transactions on Software Engineering, IEEE Transactions on Pattern Analysis and Machine Intelligence, IEEE Transactions on Knowledge and Database Engineering, IEEE Transactions on Parallel Distributed Systems, IEEE Transactions on VLSI systems*, and *IEEE Transactions of Visualization and Computer Graphics*. The Computer Society Press publishes nonperiodical literature, including tutorial texts and conference records. The society's catalog contains approximately 900 titles that are available for purchase.

The society sponsors or co-sponsors more than 100 conferences and meetings ranging from workshops and symposia with a few dozen participants to major conferences with many thousands of attendees. More than 30 technical committees offer the opportunity to interact with peers in technical specialty areas, receive newsletters, and conduct conferences and tutorials.

The Computer Society has more than 100 local chapters throughout the world and an additional 100-plus student chapters that provide the opportunity to interact with local colleagues and hear experts discuss technical issues. In addition, tutorials, educational activities, accreditation of computer science and engineering academic programs, the development of standards, and an international electronic mail network all play prominent roles in the society's activities.

Contact: Allen Parrish, Department of Computer Science, The University of Alabama, Box 870290, Tuscaloosa, AL 35487-0290, 205.348.3749, fax 205.348-0219, parrish@cs.ua.edu

ISTE—International Society for Technology in Education

The International Society for Technology in Education (ISTE) is the largest teacher-based, nonprofit organization in the educational technology field. Its official mission is "to promote appropriate uses of information technology to support and improve learning, teaching, and administration at the K–12 levels and in teacher education."

ISTE publications focus on the effects of computers, software, and other technologies on classroom teaching, curriculum, and teacher education. *Learning & Leading With Technology*, ISTE's monthly magazine, spotlights practical classroom uses of computer hardware and software. ISTE's monthly newsletter, *ISTE Update*, keeps members in touch with recent news and trends in educational technology. The *Journal of Research on Computing in Education* (JRCE), as well as ISTE's other scholarly journals, assists teachers in determining research-supported directions for technology initiatives. ISTE also publishes a wide range of books for teachers interested in enhancing instructional uses of computers at the precollege level. These publications now include the nationally recognized Generation www.Y materials as well as the National Education Technology Standards for student achievement in Grades K–12.

Major components of ISTE's teacher-outreach programs include:

- Teacher-led workshops at major conferences, offering hands-on approaches to new instructional technologies
- ISTE-sponsored conferences and leadership symposia that provide teachers with enhanced career development opportunities
- National representation in Washington with regular updates to members on issues such as E-rate and other initiatives that impact technology and education
- National accreditation standards for applying information technology in education, developed by ISTE for NCATE and NETS
- Networking through ISTE's Special Interest Groups (SIGs) that link tech coordinators, computer science educators, Logo users, telecommunications educators, hypermedia/multimedia users, and others
- More than 50 local and regional affiliate organizations whose members support ISTE goals and distribute ISTE information through their newsletters, conferences, and membership meetings

Contact: ISTE Customer Service Office, 800.336.5191, fax 541.302.3778, cust_svc@iste.org, http://www.iste.org

ISTE SIGTC—Special Interest Group for Technology Coordinators

The Special Interest Group for Technology Coordinators (SIGTC) is a professional organization that helps technology coordinators meet the challenges of a rapidly changing field. We provide an excellent forum to identify problems and solutions, and share information on issues facing technology coordinators at the precollege level.

SIGTC publishes *SIGTC Connections*, a quarterly publication, through the International Society for Technology in Education (ISTE). Articles in *SIGTC Connections* contain helpful information and answers to questions such as:

- What are some ways technology coordinators are successfully organizing and communicating with teachers and administrators?
- What strategies are technology coordinators using to enlist the support of school boards and administrators?
- How do technology coordinators keep informed of new trends and developments in this rapidly changing field?

For general information, contact ISTE (see preceding). For information on ISTE's SIGTC, contact Bonnie Marks, Alameda County Office of Education, 313 W. Winton, Hayward, CA 94544.

ISTE SIGTE—Special Interest Group for Teacher Educators

SIGTE is the ISTE Special Interest Group for Teacher Educators involved in educational technology. SIGTE provides a forum for members to share successes, raise questions, and meet the challenges of helping other professionals use technology to enhance learning and education. SIGTE publishes a quarterly journal, the *Journal of Computing in Teacher Education*, that works to provide its members with the answers to practical, leadership, research, and theoretical questions, such as:

- What is happening in K-12 computer education that relates to teacher education programs?
- What funding issues are in the forefront of current preservice and inservice teaching areas?
- What are the directions in teacher education as related to computer and technology education?
- How can educators become effective critics and implementers of innovations using technology?

Each year, SIGTE gives a cash award at NECC for the best paper describing research on technology in teacher education; the paper is presented at the conference.

For general information, contact ISTE (see preceding). For information on ISTE's SIGTE, contact: Judy Robb, University of New Hampshire, Department of Education, Morrill Hall, Durham, NH 03824, jkull@christa.unh.edu

SCS—Society for Computer Simulation

The Society for Computer Simulation (SCS) is the only technical society devoted primarily to the advancement of simulation and allied technology. It has a worldwide membership and a network of regional councils that covers the United States, Canada, the United Kingdom, Europe, and the Pacific Rim.

Simulation is used in every scientific and technical discipline, including aerospace, biomedical, business, education, engineering, and manufacturing. Areas that have been specifically recognized as important to SCS members include artificial intelligence, CAD/CAM, education, environmental issues, knowledge-based systems, robotics, simulators, and standards.

The society publishes *Transactions of SCS*, a quarterly archival journal, and *SIMULATION*, a monthly journal of applications of simulation.

In addition to the flagship Summer Computer Simulation Conference (SCSC), the society sponsors several other conferences, including the SCS Western Multiconference, the SCS Eastern Multiconference, the Winter Simulation Conference, and the European Simulation Symposium.

Contact: Society for Computer Simulation International, PO Box 17900, San Diego, CA 92177-7900, 619.277.3888, fax 619.277.3930, sbranch@scs.org, http://www.scs.org/.

NECA representative contact: Charles Shub, Computer Science Department, University of Colorado–Colorado Springs, Colorado Springs, CO 80933, 719.593.3492, fax 719.262.3369, http://www.cs.uccs.edu/~cdash

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Educating Teachers on Web-Page Building with Students

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Key Words: **Web-page building, Web-page formation, middle school students, Web-page language**

One way to motivate middle school students to write to the best of their ability is to allow them to "publish" their written work for a worldwide audience. Teaching students to develop Web pages that display their work provides the vehicle for international exposure.

While there are many commercial Web-page development programs, educators do not always have multiple copies or licenses to these programs. Meanwhile, commercial programs are not necessary to produce Web pages. With a basic knowledge of HTML (Hypertext Markup Language) a Web page can be developed as a template for students to utilize.

Topics include:

- Basic understanding of HTML
- How to use a word-processing program to create a Web page
- Examples of Web pages built by middle school students
- Grouping and management strategies

Society Session: Teacher Education and Training

Effective Teacher-Created Multimedia and Hypermedia Learning Products

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Key Words: **multimedia/hypermedia, accommodating learners, authoring products**

Until recently, teachers who wished to create multimedia learning products were required to invest many hours mastering a software development environment. Current products such as PowerPoint 97 have almost no learning curve, particularly for people who use other tools in the office suite. Similarly, Web-based tools and templates abound that enable the development of Web-based applications by people with very little previous authoring experience. Based upon the needs of the Information Age workplace, collaborative endeavors are proliferating across the grades. Teachers, in particular, need experience in collaborative learning if they are to successfully implement such initiatives with their students. The ability to meet learning needs of targeted populations with multimedia and hypermedia products is the driving goal of each team production. The role of the invisible but omnipresent virtual teacher is emphasized. Guiding interactive learning is a change in educational philosophy from the student as receiver of knowledge to the student as builder of knowledge.

One of the unique features of this collaborative development process is the fact that team members reside in different geographic areas and time zones. Most work was done asynchronously and remotely. Questions about the distance process will be fielded after the products are demonstrated. Similarly, interactive discussion about any parts of the development process will be held to meet the needs of the audience. The parts of the process include design, (needs analysis, subject matter, methodology, charts, and storyboards), authoring tools, product development, and alpha and beta evaluations. Doctoral candidates in Computing Technology in Education at the School of Computer and Information Sciences at Nova Southeastern

University developed all the interactive products in the 1998-99 school year. Representative titles and target audiences include:

- Phonemic Express (early childhood emergent reading) by Ellyn Biggs, Tracy Harris, and Jack Mara
- StoryTellers (third and fourth-grade reading and writing) by Kim Hansen, Robin Aspman O'Callaghan, and Bruce Cambigue
- Tissues of the Human Body (first course in anatomy and physiology) by Angel Rodriguez, Martha Snyder, Jeff Teo, and Gioconda Weiner.
- Beginner's Guide to Web Page Design: A Tutorial for Teachers by Pamela Laverty, Creed Wheeler, Kent Shirley, Wim Kerkhofs, and Amy Koresdoski
- Social Graces: A Menu of Meaningful Manners (post-secondary) by Donna Baker, Stephanie Karran, Melissa Templeton, and Rosemonde Wade
- Welding Careers Tutorial (post-secondary) by Joel Helms, Carl Eskridge, Kathleen Adams-Schmitt, Jeffrey Appel, and Ali Amercupan
- Better Living Through Herbs (lifelong learning) by Maureen Sullivan, Norma Gordon-Rowe, and Al Waltman

General Session: Current and Emerging Technologies

LemonLINK: The Connected Learning Community

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Key Words: **connecting a community, high-capacity Hybrid Wireless Fiber Network (HWFN), 24-hour learning environment, interactive Web-based desktop, Web-based lessons, district intranet, staff development**

The Lemon Grove School District (LGSD) and Cox Communication, the local cable television company, have partnered to deliver high-speed intranet connectivity between the district and the students' homes. Using cable modem technology and next generation set-top boxes type device (an inexpensive alternative to a computer), students can access the resources from home. Through this connected community/intranet, Lemon Grove students and residents are becoming a community of learners, linked to the information superhighway and to local sources of information including the local library, government offices, and community centers. They will have increased opportunities to build technology skills and acquire knowledge to improve their educational, career, and economic opportunities.

With literacy and student achievement being the top district priorities, the LGSD addresses the issues of equal access to technology and quality educational resources by providing a computer for every four students in the classroom. In addition, the home connection provides direct link-ups with teachers, classroom materials, and the unlimited global resources of the Internet

A major focus of LemonLINK is the development of a Web-based interactive desktop that provides student/teacher/parent access to learning tools, electronic resources, and data files from anywhere in the community. Supplemental electronic instructional units, called LemonAids, are created and used by teachers to incorporate Web-searching activities that build on the daily classroom lessons. These are assigned to students via the Web-based desktop. LemonAids provide students with a link to a variety of intranet and Internet sites and explore a wealth of materials accessible from the classroom computer or from home, 24 hours a day.

Topics include:

- A comprehensive plan for connecting schools, classrooms, government offices, and community homes using a Hybrid wireless network and cable modem technology. LGSD has partnered with city government and a local cable company to deliver high-speed intranet connectivity between the district and students' homes.
- Use of cable modem technology and a set-top boxes type device that students use to access the educational resources from home
- Demonstration of a unique Web-based interactive desktop that provides students/teachers/parents access to learning tools, electronic resources, and data files from anywhere in the community, 24 hours a day
- A comprehensive staff development program that focuses on standards-based instruction enhanced by the embedded use of technology through integrated software and Web-based instruction.

Preparing Secondary Mathematics Teachers to Teach with Technology

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Key Words: **teacher education, technology implementation, mathematics, Internet, teacher training, software**

A secondary mathematics methods course has been totally redesigned to prepare prospective high school mathematics teachers to teach with technology. The course has been transformed from a traditional lecture and discussion format to one in which technology is the focus of the curriculum. The Internet is used to gain access to a wide range of resources, which are catalogued and disseminated through a course Web site.

Students obtain model lesson plans, download trial versions of software, and participate in chat rooms with practicing teachers. Students also communicate electronically and share information with each other. Students in the course are required to fulfill a list of technology competencies. Among these are using graphing calculators and CBLs (calculator-based laboratories), locating one valuable Internet site as a resource for secondary mathematics education and another from which to download a software package, and preparing a multimedia presentation for a faculty inservice or school board meeting. Students are required to investigate a futuristic use of technology, such as wearable computers in the form of contact lenses or cell phones implanted in the ear lobe, and discuss with members of the course the implications of their findings for the high school mathematics classroom.

What should be taught in a secondary mathematics methods course? Infusing technology into the already crowded content of a more traditional course has resulted in greater student interest and enthusiasm, and a much richer curriculum. But what has been lost? What will the high school mathematics classroom look like in five years? These and similar questions will be discussed by participants in the concluding part of the session.

Topics include:

- Using the Internet as a vehicle for obtaining resources about secondary mathematics education
- Developing a course Web site for a secondary mathematics methods course
- Using graphing calculators and CBLs in a high school mathematics classroom

- Using a mailing list for electronic communication among students outside of class
- Excellent software packages for secondary mathematics classrooms
- Futuristic technology, such as wearable computers, in the classroom

Research Paper: Curriculum and Instructional Strategies

Using Higher Order Computer Tasks with Disadvantaged Students

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Key Words: **computer-assisted teaching, learning disabilities, moderate mental retardation, equal education, special education, learning theories**

Summary of the Pilot Study

Just more than four years ago, I described a pilot program that engaged a 12-year-old girl with mild to moderate intellectual disabilities in higher order computer tasks (Anderson, 1995a). The rationale behind the program was that the student, Belinda, needed to improve her communication skills, her self-image, and her social skills in order to be effectively "included" in the regular primary school setting. Studies by Means and Knapp (1991), Gerber (1994) and Sutton (1991) provided the influence to reject simple drill and practice software in favour of alternatives that would provide higher level cognitive challenges. Traditionally, disadvantaged groups have often been overexposed to simple, remedial style "drill and kill" activities at the expense of more thought provoking and creative avenues for learning. Belinda worked on the program intensively during the first year and continued to peer tutor other students during the following two years.

At the completion of the program, results were gathered and published elsewhere (Anderson, 1995b,c, 1996, 1998a) but could be summarized as including increases in spoken and written communication skills, and improvement in social skills, computer skills, and some self-concept areas. A scale of general computer skills was administered individually to the 29 regular class peers and the participant as a post-test measure. Belinda's score of 78.26% was 2.8 standard deviations above the grade norm. This supported the original proposition that she could achieve higher levels than the norm in an area requiring higher order thinking skills. Unfortunately, no formal testing was undertaken to prove the perceived increase in other dimensions, although they were strongly supported by observation from teachers, parents, and independent research teams (Lankshear & Bigum, 1998).

Due to the success of the program and the fact the students with learning or intellectual disabilities displayed some similar problems to Belinda, the program was continued with a larger group as part of a Ph.D. research program. The group chosen included all the students with mild to moderate intellectual disabilities enrolled in Year Five or Six at three different schools. This meant that students selected were not just those with a particular interest in technology and it ensured a wider range of socioeconomic status. Intervention steps were developed, measurement tools and strategies selected, and participants chosen. Interim results from the program were reported at the 1998 Australian Computers in Education Conference (Anderson, 1998a). Full details of these aspects are available at the "Literacy Web Australia" site (Anderson, in press).

An examination of the pilot study was undertaken to determine critical aspects that led to success with Belinda. These were thought to be:

a. The use of software that provided a cognitive challenge as well as being interesting with a potential for "fun."

b. Emphasis during the introduction period was not on text production but rather on using alternative means of expression, such as graphics and labels, and then more text was gradually used.

c. Peer tutoring. After the student mastered aspects of the software, she reinforced this learning by teaching others. This also led to extra spoken dialogue between the student and other members of the class, and contributed to other class members viewing the students as being an "expert" in the computer area. Peer tutoring lessons were provided as part of the intervention.

d. Feedback needed to be given constantly to the student about her progress.

e. Belinda needed to be able to actively experiment with the tools inherent in the software.

Why Do We Need Further Research into the Effects of Computer Interventions in This Area?

Many research studies and meta-analyses of studies with an equity focus concentrate on computer use and the effects of race, gender and social class difference, and more rarely students with learning disabilities. Very rarely do students with intellectual disabilities rate a mention. Sutton (1991) reviewed a decade of research in computers and equity but in her otherwise comprehensive report did not include anything at all about computers and children with intellectual disabilities. Likewise, in the U.S., Becker and Sterling's (1987) review concentrated on race, gender and social status, while an Australian review by Chambers and Clarke (1987) followed the same themes without considering equity issues related to students with intellectual disabilities.

Gardner and Bates (1991, p.98) highlighted that although numerous remarks from special education teachers and professionals assert that computers motivate learning and improve the attitudes of exceptional students, detailed empirical analysis or validation of comparable themes has generally been absent in the literature. A search of the ERIC database with the terms "computers" and "intellectual disabilities" fetched a total blank, whereas "mental retardation" and "computers" revealed only 98 articles. When these were examined to determine studies concerning students with mild to moderate intellectual disabilities, less than 10 remained. Out of these, only two looked at interventions based on higher order or challenging computer tasks and these reports did not contain compelling quantitative or qualitative evidence. These students with mild to moderate intellectual disabilities are the students most likely to be included in regular schools as a result of new legislation in Australia and other countries. This is an area where many teachers are not confident about developing educational programs of any kind, especially in areas such as computing, where they may also lack confidence.

Developing the Program with a Larger Group

The Participants

The selection was a purposeful sample consisting of all the "mainstreamed" students with mild-moderate intellectual disabilities in Years Four, Five, or Six (ages 9-12) who had completed the Queensland State School external ascertainment procedure and who had been ascertained at level five (intellectual) or above. This ascertainment ensures that a full external panel (including parent/caregiver) has confirmed that the student has an IQ level lower than 75 and is seen to require a high level of academic support. This evidence was also cross-referenced with the actual IQ test results and case histories. The group comprised the bulk of students with intellectual disabilities included in regular classrooms in the three schools. The three schools and the representative students cross a wide range of socio-economic family circumstances. All students are included in classrooms that have at least one computer and all classroom teachers have formal school computer curriculums and are expected to fulfill the information technology requirements of the Queensland Education Department syllabus in this area. The students were not selected on the basis of any previous computer experience, talent, or perceived interest in computers. Considering that this level of intellectual disability occurs in a very small incidence of the general population, this is a representative and appropriate sample.

The Intervention Steps with the Larger Group

As it is difficult to change prior negative experiences, it was very important to develop in the participants a positive computer self-concept. The first stage of the intervention involved bringing the participants together and introducing them to some enjoyable and easy to use software. For this study, the computer software, Art for Kids, was used over a period of several months. This software is easy to use, allows for creativity and experimentation, and often leads to the production of quick, positive results. The particular software used here is not critical as long as it is easy to use and enjoyable. Adventure game software or alternative art software such as Kid Pix could be used as a substitute. The important factor is to make the experience an enjoyable one and free from stress. This is based on Campbell's (1989) study that demonstrated the importance of reducing students' anxiety in relation to computer work. Campbell (1989) found that increased anxiety leads to reduced outcomes with computer work. This is especially important in the initial stages and particularly if the student does not have access to a home computer.

During this initial stage, the students' interests and needs were ascertained and recorded along with their levels of prior computer experience. This information was later used to relate their computer work to their own needs and interests, and to determine the correct time to move students through the steps. Saunders (1992) argued that students develop a personal view of the world and in order to facilitate effective learning, the teacher should gain an insight into this view. Before moving on to the higher order computer work, measures were taken of reading levels, spelling levels, academic and personal self-concept areas, and computer attitudes and self-concepts, and interview questions were administered. Using these prior experiences and student interests in their computer work is a fundamental requirement in constructivist learning theory. This knowledge must be used to pace the students so that they can develop through the steps with the correct amount of scaffolding on the part of the teacher, when needed. The correct amount of scaffolding occurs when the student is given enough help to continue but not too much assistance so that the student is reliant on the teacher (Bransford & Vye, 1989).

Once the students worked through several months of less structured, easier computer tasks, they moved on to more structured activities using Microsoft Publisher. The participants learned how to import clip art based on their chosen interest. For example, if a child had an interest in frogs, the teacher would place different clip art of frogs in a directory ready for the participant's use. Importing of clip art then formed the basis for experimentation in changing the shape or position of the clip art and generally working with clip art for several weeks. Once that skill was mastered, the participants were introduced to peer tutoring skills and attempted to peer tutor other class members about how to import clip art.

Next, the students learned how to use an appropriate border and how to add a WordArt heading. After each section, the acquisition of the skill was reinforced by peer tutoring sessions. As the participants developed with the various skills, there was a build up in the addition of text used in the desktop publishing. The students needed teacher scaffolding in order to gather suitable ideas for the text from the school library, home, and the Internet, and in editing the text used in publications. It is important that the level of scaffolding given is at the correct level, so that it is a challenge for the student but does not become frustrating. It is also important that the teacher discusses the thinking processes used with the children in order to try to increase metacognitive awareness (Peterson, 1988).

Peer tutoring needed to be continued after different steps were mastered. The effectiveness of the peer tutoring was monitored and feedback given from the teacher to help the participants develop their tutoring skills. Students were reminded about the correct steps if they gave inappropriate feedback to the tutees, so that meaningful dialogue continued. Johnson and Johnson's (1986) study supported the idea that peer tutoring can lead to enhanced verbal interactions and

Kulik, Kulik, and Bangert-Drowns (1985) found that the tutor benefited from the process as much as the tutee.

As the skills developed, more emphasis was placed on thought provoking elements of design and how the overall product related to the student's interests. The program should not be reduced to the acquisition of mechanical skills, but should have a purpose and be linked to the student's needs and interests. The thinking processes used should be emphasized and brought out into the open by the teacher and discussed as much as possible, as the program is centered on higher order thinking skills. Becker and Sterling cited in Lepper and Gurtner (1989) and Means and Knapp (1991) found that special needs students are often systematically assigned different and less challenging tasks than other students. The tasks set at each step in this intervention need to be attainable but challenging and creativity and experimentation encouraged.

In the initial implementation of the program, Microsoft Publisher was chosen as the software to provide the necessary challenges. During the final stages it became obvious that new challenges were necessary for the new group to undertake. SCALA MM200 was chosen as an excellent piece of software to further advance the progress of the group and it had the potential to allow transfer and extension of skills gained by using Publisher.

SCALA is a multimedia-authoring package that can be used to produce stand-alone multimedia shows or can be used as an effective presentation tool. Students using Publisher familiarize themselves with concepts such as importing graphics and changing font sizes and styles. SCALA allows this manipulation to a greater degree and extends the students by allowing the importation of animated GIFs and captured video. In order to facilitate the inclusion of video, the school invested in a high quality SVHS camera and a video capture card.

The same instructional strategies employed with Publisher were used with SCALA. The intervention group was introduced to the software before regular class members. After mastering functions of the software they reinforced their skills by tutoring others. Each student chose a topic of interest and then typed sentences relevant to the subject while being instructed in text manipulation via SCALA's different user interface. Later came graphic importation, animated GIF importation, video importation, and transition effects between pages. During the previous work with Publisher, I noticed that students responded positively to tools that created special or unusual effects such as WordArt. SCALA offered spectacular transitions between pages and interesting uses of animated GIFs and movies in different formats. Discussion of design aspects has been a focal point of the intervention and SCALA offered a chance to look at design in relation to a "moving" as opposed to a "static" production and therefore offered more opportunities to cognitively extend the group. Exposure to a different type of user interface proved to be an interesting challenge for the students and provided a good lesson in the diversity of computer tools. Programming could be introduced through editing of scripts, but it was decided that the students would not be able to cope with this level of computing until later in their development. If they later reach a stage where this is possible, the functions are available in the program.

In the presentation, students wrote about themselves and included a digital photo. In the future, video clips of individual students and the class will be included and the presentation will be saved as a stand-alone .EXE file, burnt on CDs, and distributed to parents with the appropriate technology to view them, or be shown at the school.

Now that my work with the larger group is drawing to a close (after two years), I am beginning to review results of formal tests, interviews, school records, videos, and audio tapes, to determine changes in the students' academic scores, communication skills, and social skills. These results will be rigorously examined in the final data analysis section of the Ph.D. document but at this stage it is obvious that many positive changes have occurred, especially in the area of verbal communication and computer skills. One student has been recently reassessed with a Wechsler Intelligence Scale (third edition) as being in the moderate range of intellectual disability (46-58 IQ). This is the lower first percentile intellectual rank, yet her reading age is in the 30th percentile. She is an extremely competent peer tutor as well as being an efficient exponent of desktop publishing. A recent Vinelands Adaptive Behaviour Scale shows only a mild communication deficit. She frequently corresponds with friends in other schools through e-mail and reports enjoying the computer work more than any other area of schoolwork. The original participant now attends the special school for the subjects of English and mathematics and the regular secondary school for art, animal husbandry, and computer studies. She has gained pass levels in the regular computing studies course and hopes to gain employment in a computer related area.

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General Session: Library/Media

Transport the Library to the Classroom

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Key Words: **library instruction, electronic resources, research techniques, remote access, library technology**

With the availability of local area networks, computerized classrooms, and Web access to many electronic databases, it is now possible to increase student awareness of library resources by conducting actual classroom demonstrations. Librarians can use a laptop computer and an LCD projector to bring library research techniques right to the classroom.

The librarian can interact with students and teachers by finding answers to assignments using the library's electronic resources. Students will learn about library resources, library research skills, and how to evaluate information. This will provide them with an opportunity to see how library resources are critical to the learning process, and at the same time encourage them to visit the library for further exploration of research assignments.

The librarian and teacher will be able to work as a team to enhance learning and increase the technological competency of their students.

Topics include:

- Web access to electronic databases
- Computerized and Internet ready classrooms
- Librarian and teacher as a team
- Research assignments
- Library research skills
- Remote access to library resources
- Tips for increasing student interest in the library

General Session: Curriculum and Instructional Strategies

Managing Classroom Computer Use: Lessons Learned from SEIR*TEC Schools

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Key Words: **classroom management, student projects, computer classroom**

Based on lessons learned through working with SEIR*TEC's intensive site schools, the presenters will discuss effective practices to impact teaching and learning. The presenters will share ideas and discuss issues relevant to effectively using technology in a one or few computer classroom.

Using real-world examples, presenters will share how students surf the Net, create electronic presentations, and develop student projects. Presenters will guide participants in an exploration of different lesson plans, curriculum resources, and instructional units that can be used with either one or more computers in the classroom. Through interactive activities and discussion, participants will learn how to ignite their own students using technology in the classroom.

A list of Internet resources appropriate for K-12 students and teachers will be discussed (www.seir-tec.org/k12.html). Different multimedia projects providing interactive opportunities for students, with particular emphasis placed on practical methods for integrating the Internet as well as other programs into existing curriculum, will also be presented.

Multimedia: Making it Happen

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Key Words: **multimedia, network services, notebook computers, professional development**

Multimedia is making a major impact on education—what and how students learn. Students are both consumers of multimedia and creators of multimedia. Applications are available on networks in schools, on CD-ROMs and on the World Wide Web.

To truly understand the power of multimedia, students need to be creators as well as consumers. Creating multimedia develops skills for critical evaluation of the multimedia students consume.

Developing multimedia requires high speed, highly reliable networks, technical expertise, technical support, and design skills. We need educators, not technical experts, to design and drive the process of content creation.

To give students the opportunities to create, publish, and distribute multimedia applications requires careful planning and significant resources. This session is a case study of how two high profile, highly regarded schools in Melbourne, Australia, have tackled the issues of infrastructure, creation and distribution of multimedia, and professional development of teachers.

Each school has entered into strategic technology partnerships with important vendors to ensure that the required infrastructure is available.

Network Infrastructure

Scotch College and Methodist Ladies' College (MLC) have both invested in Asynchronous Transfer Mode (ATM) networks to provide high reliability, high speed, and high bandwidth access. The ATM networks provide for current needs and projected growth for the foreseeable future.

The paper will demonstrate the network configurations used in each school and outline the key features in making it successful.

A wide range of network services is provided at each school. The presentation will identify and demonstrate the benefits of the network services. Future network services will also be identified including video on demand, videoconferencing, and online curriculum materials using the technology of the World Wide Web or the schools' own intranets.

Other issues such as cabling, building design, furniture, and technical support will also be considered.

Notebook Computers

Each school has a well established programme using notebook computers in the curriculum. MLC has 1,950 students using notebook computers from Year 5 to Year 12 and Scotch College has 500 students in Years 11 and 12 using notebook computers.

Particular attention will be given to the issues of students using notebook computers in the curriculum in a networked environment. Issues considered include the types of access, network design, classroom design, and the impact on the way students learn and how teachers teach. Australian schools have led the world in embracing mobile computers in education.

Other issues to be considered include types of computers, the process of purchasing, updating, software installation, network infrastructure, and support.

Creating Multimedia

The tools required for the creation and distribution of multimedia applications will be considered. In particular, the following will be identified:

- Computer configurations
- Specialist computers and peripherals
- Design issues
- Publishing options including CD-ROM and the World Wide Web
- Software
- Curriculum goals
- Technical support
- Professional development

In addition, a number of examples of student work will be shown ranging from the primary classroom to upper secondary.

Professional Development

The professional development of teachers is key to the empowerment of students in the use of computers and the production of multimedia applications.

Teachers at each school are provided with their own notebook computers and they have an obligation to participate in a significant amount of professional development every year. They are expected to develop their expertise and to integrate the use of the computer into the curriculum.

Different models of providing professional development will be provided, as well as an evaluation of each model.

The types of professional development include:

- In-house courses conducted by teachers—often short courses run before school, at lunchtime or after school
- Courses conducted by outside experts, after school or in evenings
- Professional training at an external location
- Using community education courses conducted by the school for teacher education
- Participation in conferences
- Using an outside expert, at a school, for short term courses or as a consultant for several weeks
- Conducting in-house miniconferences based on a theme and providing staff the opportunity to choose from a range of electives

Summary

For students to learn and master multimedia, it requires a combination of funding, strategic planning, network design, professional development, and a vision for the future. Both Scotch College and Methodist Ladies' College have the vision, drive and energy to turn the creation and delivery of multimedia into reality across their campuses.

About the Authors

Greg Baker is Director of Computing at Scotch College in Melbourne, Australia. Scotch College is an independent K–12 school for boys with 1,750 students. Baker is responsible for all computing within the college which includes around 800 computers and 500 students with their own notebook computers. Scotch College implemented an ATM network in 1998. Baker is co-author of *First Byte* (3rd edition, 1998) and *Doing IT* (1997) published by Oxford University Press. He has presented at conferences in several states of Australia as well as at WCCE95 in Birmingham, United Kingdom, and NECC '97 in Seattle.

Leon Guss is Director of Computing and Multimedia at Methodist Ladies' College in Melbourne, Australia. MLC is an independent K–12 school for girls with 2,200 students. All girls from Year 5 and all teaching staff have their own notebook computers. Guss is responsible for the notebook program and also multimedia within the college. He also acts as the college's Web manager. Prior to joining MLC, Guss worked for several years with Apple Computer Co., Australia.

General Session: Exhibitor

Implementing Technology-Based Units That Spotlight the Traditional Curriculum

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Key Words: **curriculum integration, simulations, database software, student projects**

Experience one teacher's implementation of a project-based unit integrating curriculum through a CD-ROM simulation, then overview the same format with database/student-presentation software. Participants will investigate Steck-Vaughn's Multiple Media Learning Modules/Investigation Stations, which integrate the traditional curriculum with technology through project-based units incorporating two types of CD-ROM software. The first module focuses on the social studies theme of Westward Migration and uses a computer simulation—the homesteading of a Kansas farm in the 1880s—as the vehicle for problem solving and decision making. Reading, researching, writing, working with hands-on manipulatives, and creating projects are connected through activity-centers, a format designed to synergistically relate to the software. Actual classroom use is documented through photos and samples of completed projects from a fifth grade class in Cleveland, Ohio. The second Investigation Station reflects a primary level theme, using a CD-ROM database to develop concepts and allowing students to create their own multimedia "shows" as evidence of their understanding. The programs utilizing this format range from kindergarten through eighth grade.

Topics include:

- Overview of a multiple media learning module format which integrates traditional instruction
- Authentic examples of classroom application and the resulting projects
- Exploration of two types of software (a simulation and a database)
- PowerPoint slide show of a fifth grade class using the materials
- Sharing of student work and reflection

- Audience-led exploration of software
- Evaluation of materials

General Session: Curriculum and Instructional Strategies

Whizz-Bang Presentations Using Art to Illustrate the K–12 Curriculum

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Key Words: **art, curriculum, K–12, staff development, training, laserdiscs, bar coding**

Description

Laserdisc technology offers visually stimulating enrichment for the curriculum. This session will demonstrate how images bar coded from laserdiscs of art collections can be used to bring "the textbook to life" in multiple subject areas and grade levels. Examples will be shown of how to make the bar codes and customize lesson plans for individual teachers' needs.

Summary

The purpose of this presentation is to demonstrate teaching strategies for incorporating laserdisc content into the K–12 curriculum. The format will be a constructivist model approach with guided discussion on a journey weaving art into the other curriculum areas, utilizing laserdisc technology in presenting lesson plans. Excerpts will be shown from a range of affordable and exemplary titles and will provide attendees with lesson plans and other valuable handouts.

Pioneer Mentors are a special group of teachers selected from around the United States. We were chosen for our skills in integrating technologies into the curriculum. We have been specially trained to make extremely interesting and informative presentations to our peers. Each of us is a classroom teacher and we are passionate about helping other teachers explore the best ways to integrate technology into their classrooms. Curriculum comes first in our minds, with the technology tools supporting curriculum goals.

We are not selling products, nor promoting specific publishers' titles. We are demonstrating methodologies and sharing various tools and programs we have used for successful teaching within our classes.

As a group, we are individual recipients of many awards, from Teacher of the Year in our states to the most current recipient of the Ameritech Teacher of Excellence Award. The Pioneer Mentor Program has also won its own recognition. It recently was awarded Curriculum Administrator's Best Products Award, which is the first time an industry-based service program has ever been given this honor.

General Session: Exhibitor

Workforce Development Training: From BackOffice to Software Development

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Key Words: Microsoft, IT career, training

The Microsoft Authorized Academic Training Program (AATP) is a program that enables academic institutions to deliver Microsoft authorized courseware on Microsoft development tools and server products. AATP makes training and resources available to students who want to pursue a career in the exciting IT industry, especially students who otherwise may not have access to such training. Through AATP, high school students, degree-seeking students at institutions of higher education, and students training for new careers have the chance to gain the skills and knowledge they need to succeed in positions such as network administrator, technical support representative, programmer/analyst, and database administrator.

This presentation will be a panel discussion with faculty who have successfully implemented AATP. The panelists will discuss internship and career opportunities for their students as a result of AATP. The panelists will also highlight Articulation Agreements they have developed to give students college credit for AATP courses taken during high school. Audience participants will have the opportunity to ask questions of any panelist.

There will also be a discussion of the Microsoft Office User Specialist (MOUS) program, which tests and certifies user proficiency on Microsoft Office applications. Discussion will include program elements, benefits to faculty and students, implementation steps, and adopter success stories.

This session will provide the opportunity for those considering launching AATP at their institution to hear it straight from the implementers, those most credible. There will also be an opportunity to hear the tremendous opportunity the program has provided for students across North America.

General Session: Curriculum and Instructional Strategies

Student-Created Web Pages and the State Standards of Learning

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Key Words: **SOLs, Internet, Web pages, students, training, curriculum**

Last year the state of Virginia developed new Standards of Learning which included a technology component. In preparing our fifth graders for this, while continuing our technology initiatives, we needed to find an interesting and informative way to meet the standard. Creating student-designed Web pages is an exciting, innovative way for the students to use their researching skills to showcase learned information.

Some of the benefits gained by building a Web page is that students use both sides of the brain, which helps them remember the information. Students work in a media that is visually exciting and multisensory, maintaining a high interest throughout the creation and movement of hyperlinks. Good research habits and structured thought processes are reinforced using logical steps to present learned information that is accessible to other grade levels. The students will use problem solving skills in the decision making process of creating this Web page.

A digital camera, a scanner, and the Internet are some of the tools that will be used by the students. The software used for this project is Claris Home Page. Along with the hardware needed to create these Web pages, students have access to a variety of specialists in the building.

The attendees will learn how the Mantua students created a Web page that integrates the subjects of the curriculum. The student population at Mantua Elementary School is comprised of general education, English as a Second Language, deaf, learning disabled, and gifted and talented students. The attendees will receive a guide that illustrates how this technology can be implemented in their program. A question-and-answer period and viewing of the Web pages will be provided.

Society Session: Using Technology to Facilitate Learning

Response Panel for the National Survey of Technology and Reform

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Key Words: **research, implications for practice, scaling up, implementation**

The national survey findings discussed in the NECC presentation "TLC-1998: The National Survey of Computer Technology and Instructional Reform" will be given a thorough and critical analysis by four major individuals in the educational technology research and development field:

Chris Dede is Professor of Education at George Mason University, recently having returned from a stint at the National Science Foundation. Dede is well-known for his insights into future technology trends and their impact on schooling and society. Beverly Hunter has recently become Co-Director of the Learning Communities Research Group at Boston College. Hunter was an early software developer and critical advocate for educational technology. Arthur Luehrmann has spent several decades developing appropriate models for student use of computer technologies, and originated the term "computer literacy" when computers were known as "teaching machines." Robert Tinker is President of the Concord Consortium and was Chief Scientist and the founder of TERC, one of the primary innovators of computer-based tools for science education in the United States.

Topics addressed are:

- Summary of the Teaching, Learning, and Computing national survey and its major findings.
- Implications of the survey findings for the practice of teaching.
- Implications of the survey findings for the implementation of computer-based approaches to teaching and learning.
- Implications of the survey findings for the scaling up of technology-embedded reform, and for future expectations regarding technology's use by teachers in schools.

Spotlight Session: Technology Implementation

The 7 Habits of Highly Effective Technology-Using Educators

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Key Words: staff development, teacher productivity, training, motivation

Why is Steven Covey's book, *The 7 Habits of Highly Effective People*, so popular? Maybe it's because it's a philosophy that translates to most fields, most walks of life, and maybe because it's based on common sense.

Let's take a look at the habits one at a time.

1. Be proactive.

Effective technology-using teachers don't wait for the perfect software, the perfect opportunity, the perfect lab, or the perfect student. They do it. They are realists and realists know that effective use of technology doesn't mean that technology never fails.

2. Begin with the end in mind.

All teachers plan. But effective technology-using teachers plan, plan, plan, and then, knowing things happen with technology, create Plan B. Effective technology-using teachers choose hardware, software, and technology with desired student outcomes in mind. It becomes an integral part of the instruction, not an add-on.

3. Put first things first.

What is the first thing for effective technology-using educators? The first thing in education must always be our students. Schools exist for the benefit of students. We must focus on our students and use technology as a means to the end: helping them learn and achieve.

4. **Think win-win.**

   We create a win-win situation when we help students come to their own discoveries instead of spoon-feeding them information. We create a win-win environment when we create a safe climate that encourages and rewards both risks and accomplishments.

5. **Seek first to understand, then to be understood.**

   If we can learn to listen and start with the needs of others, instead of our own agendas, we can begin to see the bigger picture.

6. **Synergize.**

   Synergizing means getting people to work cooperatively and collaboratively to help your school survive and thrive. That means they must be aware of your goals, buy into them, and establish them as a priority. Synergy! People working together to achieve common goals.

7. **Sharpen the saw.**

   Effective technology-using educators preserve and enhance their greatest assets: themselves. Take care of yourself and your "tools" so that you can get the job done most efficiently and effectively.

Visit some of our projects on the Web:

- SUNLINK—www.sunlink.ucf.edu/
- NEON—www.itrc.ucf.edu/neon/
- Florida Department of Education Software Catalog—www.itrc.ucf.edu/doecat/
- K-12 WebLinks—www.itrc.ucf.edu/k12db/
- Sunshine State Standards (Technology)—www.itrc.ucf.edu/sss/
- Integrating the Internet (Course)—http://reach.ucf.edu/~eme6053/
- Library Automation and Information Power (Course)—http://reach.ucf.edu/~eme6058/
- SEIRTEC—www.itrc.ucf.edu/other/seirtec/

General Session: Teacher Education and Training

Information Technology in Teacher Education: Implications of a National Survey

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Key Words: **teacher education, preservice, training, research, technology integration**

Teacher training in the United States has been criticized in the past for not playing a larger role in technology preparation, and recent initiatives such as the NCATE/ISTE Standards have attempted to address these needs. A 1998 survey conducted for the Milken Exchange on Education Technology was designed to provide baseline data on the current status of IT in teacher education, and to create an instrument that would allow comparisons of the relative capacity of different programs.

The survey, conducted by the International Society for Technology in Education, consisted of 32 questions about coursework, faculty capacity, technology infrastructure, field experience, and the skills of graduates. Questions were developed by an advisory panel of researchers, professional organization representatives, college deans, and faculty. The survey was distributed nationwide. About a third of U.S. teacher training institutions responded, accounting for about half of the annual teacher graduates.

In general, the survey results suggest that true integration of technology in teaching practice is the best indicator of program quality. Questions dealing with integration (such the modeling of IT use, or the ability of graduates to organized technology-based student projects) were more highly correlated with overall scores than were questions about technology capacity, field experience opportunities, or the ability of students to use particular kinds of technology. When respondents were asked to add open-ended narratives about the notable features of their programs, the top-scoring schools tended to emphasize integration, followed by hardware/networking infrastructure and course requirements.

The emphasis on course requirements is notable in that this survey found little correlation between numbers of credit hours in IT and survey scores. This suggests that policy makers and administrators should be cautious about basing IT preparation simply on credit hours. The quality of IT training (whether formal courses or instruction integrated into other subjects) and the opportunities to apply new learning in classroom practice, may be much more important than the number of credits.

Technology planning, another commonly-cited indicator of program quality, was also not highly correlated with high scores. Again, the presumed explanation is that qualitative differences in the implementation of plans are more important that the presence or absence of a document.

Members of the project advisory committee will discuss these and other findings, along with implications for policy, practice, and further research. Attendees will receive a copy of the final project report.

General Session: Technology Implementation

Profiling Progress in Integrating Technology

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Key Words: **technology implementation, evaluation, rubrics**

Parents, local school districts, states, federal government, businesses—all have been investing in technology for schools to use to improve student achievement and teaching strategies. Now they are asking if the technology is making a difference. For most educators, there is barely enough time to work with the technology within the ongoing instructional program. Little or no time is being spent tracking progress to answer the tough questions of the investors or to conduct a formal evaluation.

Presenters will review the tools being used by the SouthEast and Islands Regional Technology in Education Consortium (SEIR*TEC) to track progress in implementing technology. The focus of the set of tools is on how technology is impacting the areas of students as independent learners, teachers as creators of materials, availability of connectivity and resources, existence of support for the technology program, and involvement of the community. The tools discussed and samples provided are to be used to profile the school in these areas, not to evaluate or grade the school. Once the initial school profile is developed, progress can be tracked periodically by repeating the profiling process. The process for developing and applying one of the tools, SEIR*TEC's Technology Integration Progress Gauge, will be described, including the pros and cons of using such an instrument.

The other tools to be reviewed include innovation configuration charts, the CEO Forum's STaR Chart, grant evaluation tables, the Milken Exchange's indicators, and rubrics developed by several of the Regional Technology in Education Consortia. Attendees will receive a chart comparing these instruments. Stories about the use of the various tools will be related by video vignettes and case studies. Attendees will participate in a profiling activity and receive sample tools and lists of resources (articles, books, and URLs).

Presenters Margaret Bingham and Dr. Elizabeth Byrom of the SouthEast and Islands Regional Technology in Education Consortium, one of the federally funded technology consortia, have worked together for the past three years to guide states and selected schools in the southeastern U.S. in tracking the progress of technology implementation. Byrom has a background in educational technology with experiences in technology plan development and grant proposal writing, project implementation and evaluation, educational research, and documentation of best practices. Bingham served as an instructional technology leader for the state of North Carolina for more than 18 years and has experience in curriculum development and assessment, professional development, technology planning and evaluation, and project implementation and reporting.

General Session: Social and Ethical Issues

Equity of Access to Technology for K–12 Language-Minority Students

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Key Words: **equity, race, ethnicity, Internet access, minority, ESL, language minority**

Statistics from such sources at the U.S. Department of Education's "The Condition of Education 1997" and 1998, show some disappointing results in terms of how much access language-minority groups have gained in recent years in the K–12 public school environment. That data and reports from other sources, such as the Educational Testing Service, the Bureau of the Census' Current Population Survey

(CPS), the Association for Supervision and Curriculum Development (ASCD), the National Clearinghouse on Bilingual Education (NCBE), and the Center for Applied Linguistics (CAL), Northwest Educational Technology Consortium, and the International Reading Association, show that not only has the technology gap between language minorities not been closed, but the uses to which technology is put with minority-language school populations are not necessarily the same as with the rest of the population.

This review and analysis of U.S. Department of Education data and other key research tracking the use of technology among K–12 language-minority students (including possible solutions and recommendations) will compare access to technology in the school and at home, for K–12 students. The difficulty in isolating data for language minorities lies in having to combine a number of sources of data to attain a whole picture. While Department of Education Statistics track race and ethnicity, they don't necessarily track English language proficiency. So, this report looks at a variety of combinations: race, ethnicity, socioeconomic status, use of computers (specific purposes within the classroom), location of computers (administrative, classroom, educational), use of the Internet, access to computers in the home, and more.

The results are disturbing. All the sources agree that the combined factors result in a definite technology gap that must be addressed very specifically and consciously to prevent it from growing. The link between the likelihood of language-minority students attending urban schools, being eligible for free or reduced price lunch, and the resulting lower access to technology is clear as is access to computers in the home related to income and native language. But the most telling data reveal that when language-minority students do receive access (and that excludes certain language minorities, who get no access), it is often limited to remediation and programming and not to the more creative and open-ended uses that are provided for the rest of the K–12 school population. Most of the sources agree that this is not a conscious effort. In fact, a variety of factors are at work: either schools are functioning under erroneous cultural and language assumptions; there is a lack of information about existing ESL and bilingual software and Web resources; there has been a history of too much reliance on "Title VII" programs to solve language-proficiency issues; and/or there has been a lack of record-keeping to ensure equity of access.

Most of the sources agree on the solutions that must be implemented. These include: conscious recording of the use of computers in the schools, and providing instructional computing and Internet access in more classrooms in urban, lower-economic status schools (versus "Title 1" and "Chapter 1" labs). Solutions also include ensuring that language-minority students are not just using computers for remediation and drill and practice, and that they are not being "tracked" into word-processing, old-fashioned programming, and other low-level uses of computing.

Leadership and the New Technologies: Online Workshops for Education Leaders

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Key Words: **professional development, online workshops, network infrastructure, acceptable use, special needs**

Leadership and the New Technologies (LNT), a joint project of the Harvard University Graduate School of Education and Education Development Center, Inc. (EDC), provides a series of face-to-face and online professional development activities for school and district leaders. A central goal is to develop an ongoing community of education leaders working together to address the changing needs of schools in the Information Age. One key component of this project is providing online workshops designed to help decision makers as they develop plans, policies, and programs to support the effective use of technology for teaching and learning. Topics for these workshops include the following: using technology to help students meet curriculum standards; designing a network infrastructure; addressing issues of student safety and acceptable use; employing technology to help meet special needs; and exploring leading-edge applications and their educational potential.

In developing these workshops, we have been exploring how to translate materials and processes used in face-to-face workshops, such as the use of teaching cases and small group discussions, to the environment of text-based, asynchronous, online workshops.

In this general session, we will showcase some of the archived LNT online workshops, discuss the principles underlying their design, demonstrate the tools used by participants and facilitators, and summarize the lessons we have learned so far about this new vehicle for professional development.

Participants will be introduced to the potential of the online environment for both supporting and enhancing face-to-face professional development. They will learn about various Web-based resources and activities currently available to educators, and they will gain an awareness of the underlying principles and lessons learned from this model of supporting educators.

Glenn Kleiman is Vice President and Senior Scientist at Education Development Center, Inc. (EDC), and on the faculty of the Technology in Education program at the Harvard University Graduate School of Education. He is the director of EDC's Center for Online Professional Education and of the Harvard/EDC Leadership and the New Technologies program. He led the LNT online workshop entitled "Envisioning the Possibilities: Connecting the Internet with Curriculum Standards and Frameworks" (spring 1998). Libby Black is Internet Specialist for the Division of Learning Services of the Boulder Valley School District in Colorado. She was Associate Chair of the 1998 LNT Summer Institute, and led the LNT online workshop entitled "Keeping Kids Safe: Policy Implications of the Internet in Schools" (fall 1998). Terry Dash is Research Associate at EDC. She has extensive experience with online community-building tools, and coordinated the development and facilitation of the LNT online workshop entitled "Planning a District-Wide Technology Infrastructure" (fall 1998).

General Session: Curriculum and Instructional Strategies

Strategies for Improving Your Web Research

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Key Words: **World Wide Web research, student research, research strategies**

In this session, participants will walk away with a set of strategies that can help them be more effective users of the World Wide Web for research. This will assist them in their own work and be something they can teach to their students.

We will begin with some reflection on what people do when they do research. How do they know where to look? What do they look for? How are these questions and/or answers different when electronic resources are part of the mix?

The presentation will consist of demonstrating each of the following research strategies and examining the appropriate circumstances in which to use them:

- Simply typing in the keyword or words for which you want to search
- Advanced searches in which you use operators (+, -, and, or, not) and the power of particular search engines, to be more specific
- To use a metasearch such that you are searching in several different places at one time

- Successive searching in which you narrow and broaden your search terms based upon the results you get for keyword searches
- Category browsing in which you browse through categories instead of using keywords
- Going directly to a specific site that is likely to have the type of information which you are looking for
- Using e-mail, mailing lists, and NetNews to get information from people

Participants will have a short opportunity to test these strategies. The strategies and the "self-test" questions can be found on the Web at http://bvsd.k12.co.us/curriculum/research/strategies.html.

General Session: Curriculum and Instructional Strategies

Articulated School-to-Work Technology Training

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Key Words: technology training, workforce, high school, college, business, industry

The need for technology training is pervasive as we move into the Information Age. There is a current shortage of technology literate workers across all fields of employment, and trained information technology professionals are in great demand in the workforce. These needs are projected to grow quickly in the next few years. Articulation between education and industry can begin to meet these needs.

Businesses that are currently involved in training their workforce to meet technology standards can and do provide direction to secondary schools and colleges. By incorporating business standards, educational institutions can begin preparing a technology literate citizenry. Articulation is a win-win situation, allowing educators to do the training that is within their expertise and allowing businesses who employ trained individuals to focus on their primary purposes.

This session will detail successful articulation training, providing specific techniques and strategies that target business and industry standards. The major focus will be technology training that promotes successful transition to employment. Both general technology literacy and specific information technology training will be included in the presentation.

The four presenters in this general session have worked individually and together to discover training techniques that work well across the curriculum and that assist articulation from school to work. They will discuss their individual experiences in a round-table format, encouraging audience participation. Strategies to be detailed include aggressive professional development programs, distance education, internships, multi-modal technology training, problem solution exercises, and standards identification and evaluation. The presenters will use multimedia, PowerPoint, discussion, and print to communicate ideas.

The presenters are Dr. Jane Bloomquist, a trainer with the Chicago Public Schools Department of Learning Technologies. The school district offers Novell certification, Cisco, and Microsoft training to teachers and students, and integrates technology training across the curriculum.

Bill McMillan is Director of Telecommunications and Workforce Programs for the City Colleges of Chicago. He works with business and industry to integrate standards for articulation from secondary and community college to higher education and employment. His expertise with distance education and professional development is recognized nationwide in articulation programs.

Susim Munshi is an educator who started his own business to provide professional development for K-12 through college environments. His particular emphasis is technology integration across the curriculum.

Gina Orbe works for Lucent Technologies in their training department. She is involved in direct technology training for the workplace, introducing new employees to the Lucent environment, and updating current employees on changing technologies.

General Session: Staff Development

Technology Staff Development: Too Depressing to Even Think About

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Key Words: **staff development, CBAM model, training, adult learning**

We've learned from every mistake there is and have the bruises to prove it. These successful strategies are guaranteed to be fun and productive.

Summary

Focusing on client-centered staff development is critical, but challenging in a world of access to increasingly varied and complex resources. This interactive presentation will provide the participants with specific strategies to help them design staff development models that reflect the needs of their "customers," use adult learning theory, and avoid the clichés of traditional training formulas.

The session content will be built around our almost 20 years, each, of experience with technology staff development. In addition, it will reflect the work of leaders and researchers in the field such as Senge, Covey, Harvey, DuFour, Fullan, Hall, Glasser, Joyce, and Showers. The emphasis of this session will be on designing staff development around the needs of the participants using the CBAM model, adult learning theory, and staff development pitfalls (the source of our bruises). The topic is broad, but the session will provide realistic and specific strategies for teachers, site leaders, administrators, and central office support personnel. It is our intention to give them strategies that will leave them feeling and being more empowered, while having fun along the way.

Both Johnson and Bly have been involved in using microcomputer technology since the 1970s. In addition to being a high school teacher who used technology in his classroom, Johnson has spent more than 10 years as the Director of Information Services and Education Technology for both large and small schools districts. In this capacity, he has provided technical and training support for cutting-edge technologies used by instructional and non-instructional school employees. Bly was an elementary teacher who used technology in the classroom. After working for several years as her large district's Coordinator of Technology Staff Development (K-12), she spent seven years as the principal of an elementary school with more than 200 networked computers. Currently, she is the Director of the Student Achievement Team, working again with K-12 site administrators and staff.

Introducing Teachers to the Net: How to Do It

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Key Words: **teaching, education, technology, Internet, teachers, staff development, training**

So, your school is connected, or soon to be connected, to the Internet, and you have a building of already-busy teachers who aren't sure exactly what it is and how they might use it in their classrooms. Develop a training and support plan to help all teachers get started. Focus on answering the following key questions:

- What goals should we set for the training?
- How do we decide who to train first?
- How much training should be provided at one time, and in total?
- How should we schedule training?
- What Internet tools do we present to teachers new to using the Internet, and in what order?
- Should we do the training with our own staff or work with a college or other organization?
- Should we offer the training at our own school or somewhere else?
- How can we make sure that technical issues and computer jargon don't dominate the instruction?
- What materials should we use?
- How can we give teachers ideas on how to develop and implement Internet activities in their classrooms, given the constraints of computer access in our school?
- How can we assure that Internet activities will be curriculum-based?
- How can we get teachers to actually use the Internet in their classes?
- How can we provide follow-up support to teachers newly trained in using the Internet?

- What acceptable use policies should be established for students and teachers?
- What netiquette guidelines should be provided?
- How can we keep our children safe when using the Internet and how can we make sure they don't access inappropriate materials?
- Should we obtain and, if so, in what ways, permission of parents before children use the Internet in our school?

And, one last comment—don't forget to have fun exploring with your teachers the potential of the Internet to enhance the learning of our nation's greatest resource—our children.

Sheryl Burgstahler is Assistant Director of Information Systems, Computing, and Communications at the University of Washington. The content of this handout comes from several books in the New Kids on the Net series published by Allyn and Bacon. She is the author of: *New Kids on the Net: A Tutorial for Teachers, Parents and Students*, *New Kids on the Net: A NetWork Sampler*, and *New Kids on the Net: Internet Activities for Young Learners*. She has co-authored three books with content-area specialists—*New Kids on the Net: Internet Activities in Secondary Mathematics*, *New Kids on the Net: Internet Activities in Secondary Science*, and *New Kids on the Net: Internet Activities in Elementary Language Arts*. Examples used in the presentation are from books in this series.

General Session: Curriculum and Instructional Strategies

Information Age Journey Down the Oregon Trail

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Key Words: **curriculum, instructional strategies, social studies, technology integration, evaluation of instruction**

The purpose of this general session is to demonstrate the integration of technology into a social studies unit about the Oregon Trail. The presentation will begin by identifying examples of curriculum standards and student outcomes for the unit. Attendees will be introduced to a variety of software, online resources, and other suggestions for activities intended to actively engage students in the learning process while they successfully complete the curriculum outcomes and meet standards.

The ideas and techniques presented in this session can be generalized to other curricular areas and grade levels.

Topics include:

- Examples of state and district level standards and benchmarks/outcomes
- Informational CD about the Oregon Trail created by a group of Wyoming gifted and talented students
- Location of online resources (www.rails.org/Oregon.html)
- Use of selected commercially developed software related to the unit (WebWhacker and Oregon Trail III, etc.)
- Example of an evaluation tool that helps measure the effectiveness of lessons that integrate technology into their design/presentation

General Session: Staff Development

Supporting Professional Development through Online Collaboration

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Key Words: professional development, online discussion, elementary mathematics education

MIPS-Connect is a year-long project which electronically connects elementary teachers participating in a professional development program. The MIPS (Mathematics Improvement through Problem Solving) program consists of a series of workshops and seminars based on teachers using students' thinking to make instructional decisions in mathematics. MIPS-Connect provides an ongoing forum for a subset of these teachers to share experiences, encouragement, efforts, successes, frustrations, questions, content, and so on, related to implementation of the professional development program. This leads, potentially, to increased reflection about the teaching and learning of mathematics, developing and reinforcing the participants' roles as reflective practitioners. This asynchronous Web-based discussion forum, created and managed with Lotus Notes and Domino, is examined in light of some of the benefits of computer-mediated communication, as well as potential drawbacks.

In addition to supporting professional development in teaching mathematics, participation in MIPS-Connect may also develop teachers' technical skills. Participating teachers are provided with a computer, modem, and Internet account to facilitate access to the forum, and they attend a training session which addresses both technical and discussion forum skills and processes. Most of the teachers began the project with little or no experience with computers and the Internet, but many have quickly become experienced "surfers."

This session includes:

1. a summary of current thought regarding the use of online discussion forums, including characteristics, benefits, drawbacks, and suggestions for success;
2. an overview of a social constructivist conceptual model as applied to online discussion;
3. a description and demonstration of MIPS-Connect, our online forum which contributes to the goals of the MIPS professional development program, as well as the goals determined by the participating teachers themselves; and
4. a discussion of lessons learned through this project, and how this model may be applied to other professional development opportunities.

General Session: Teacher Education and Training

Publishing in Professional Journals on the Web: Planning to Posting

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Key Words: **electronic journals, Web publication, multimedia, online journals**

This session highlights important considerations in writing for publication in electronic journals. Presenters report on the process of writing for Web publication, highlight experiences of working with authors who publish in this medium, and provide information on technical aspects of Web design.

Issues of electronic authorship that are addressed include:

- Reconceptualizing print texts for electronic publication
- Incorporating multimedia and interactive features into content
- Making decisions on the relevance of links to provide background information
- Creating a format that allows readers to move among files with ease
- Setting limits on the size of multimedia to permit easy access by the average user
- Establishing portability to allow files to be moved from one server to another

Handouts include guidelines for writing for electronic publication, resources for Web publishing, and submission requirements for online journals.

General Session: Curriculum and Instructional Strategies

Sifting for Substance: Evaluating Web Sites

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Key Words: **World Wide Web, staff development, K–12, higher education, curriculum, research**

With the multitude of Web sites on the Internet and more appearing every day, it is a chore for educators to know which sites have the quality and the research base appropriate for student and teacher resources. One of the crucial aspects of integrating the World Wide Web into the curriculum is that the practitioner and students understand how to evaluate a Web site for substance, not just for the "bells and whistles" which often offer no more than eye appeal and amusement. The lack of content quality control and the lack of discrimination among users (especially students) make the evaluation process a necessity.

The techniques and tips offered have been gleaned from thousands of hours evaluating Web sites to be used with inservice and preservice teachers. These techniques have been used successfully in staff development and professional development classes and workshops offered in the Monroe City Schools, and at the Northeast Louisiana University College of Education. They offer an overview of the principles and practices of Web site evaluation strategies focusing on the relevance, credibility, and value of information available on the World Wide Web. This overview will facilitate meaningful use of the Web in the delivery of curriculum.

Topics include:

- The necessity of evaluating Web sites
- The use of credible Web sites, search engines, and directories to find quality Web sites
- Pragmatic tips for evaluating the targeted Web site content
- Principles and practices of Web site evaluation strategies, focusing on the relevance, credibility, and value of information available

General Session: Curriculum and Instructional Strategies

Put Your Kids on the Net Using AppleWorks

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Key Words: **staff development, training, Internet, ClarisWorks, AppleWorks**

A great number of schools use ClarisWorks (now known as AppleWorks). This session will show how easy it is to make a Web page with AppleWorks. The ease of use in this program will show educators how simple it is for their students to turn research projects into Web pages that can be viewed in an intranet or Internet situation. This will allow students to do more than take information from the Web; it will allow them to contribute well-designed pages to it.

You will learn how to create Web pages with text, graphics and links, and open them in a browser. Examples of elementary and secondary pages will be shown. The session will begin with a brief review of research on student use of the Internet. The differences between intranet and Internet will be explained with strengths and weaknesses of each discussed. A Web page with text in varying sizes and colors will be created. Graphics and links will be added. The links will include links to well-known "safe" pages for students (like CyberKids, NASA, weather forecasting sites, etc.). The page will be opened in a browser and links will be tested. If an Internet link is provided in the room, the links to the "safe" pages will be tested followed by editing the page after browsing. Examples of student-created Web pages will be shown. A question and answer period will be provided.

General Session: Library/Media

School Library Media Centers: Linking Learning and Technology

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Key Words: **school library media center, technology integration, curriculum, lesson plans, administration, teachers, training**

The library media specialist's role in bringing technology to administrators, students, and staff is examined. The presenters will discuss successful administrative activities and provide lesson plans.

Technology has brought dramatic changes and possibilities to the lives of students, teachers, and administrators. The library media specialists have had a central role in bringing these changes to a suburban Maryland county school system. Global Access, which is the name of the county-wide technology plan, provided media centers with computer networks. The library media specialists were identified as pivotal positions in adapting these new technologies. As leaders, as trainers of other teachers and staff, and as co-planners of school-based instruction, the library media specialists received frequent training on a variety of technology skills and applications.

During two summers, countywide technology academies offered teachers opportunities to learn computer basics and application programs, and to consider how to incorporate technology into their curriculum by designing technology-infused lessons. Specific media specialists were the academy trainers. These academies were designed to prepare teachers to become mentors at the school level.

Administrators were informed of county technology goals throughout the implementation process via meetings, workshops, and e-mail communication. Administrators identified key people to help infuse technology at the local level. Library media specialists were selected as part of the school leadership teams to increase technology use by staff members and students.

Online services and networked programs were purchased at the central level to provide a uniform basis for county-wide inservice instruction. Library media specialists were involved in the selection and training of these programs. Additionally, the media specialists trained staff and taught students how to use these applications.

Some principals and administrators met regularly with media specialists to design benchmarks of technology knowledge and skills, create objectives, write curriculum, and implement objectives through local inservice workshops and shared expertise. The presenters will detail these steps.

Participants in this session will hear how media specialists have changed their learner outcomes to reflect the changes brought about by various technologies. Participants will receive examples of local school technology plans, research models, staff inservice handouts, and adaptable instructional lesson plans for Grade 6 through 8. These technology-infused lesson plans have been developed at two nearby middle schools and reflect cooperative planning between media specialists and classroom teachers as well as between two media specialists. They have all been used successfully in classrooms. These lesson plans cover: media center skills, general research, English, social studies, foreign language, math, and other curriculum topics.

Research Paper: Current and Emerging Technologies

Simulations for Lifelong Learning

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Key Words: computer simulations, EcoWorlds

Abstract

Computer simulations are one promising tool for supporting learning at all levels—from elementary school to workplace learning. Learning through simulations, either by creating simulations or by exploring existing ones, helps learners develop a deeper understanding of the concepts being simulated. Learning about simulations is also important since simulations are frequently employed to make predictions or test ideas by scientists and policy makers. In this paper, we describe a number of simulations that have served as tools for a variety of lifelong learners, ranging from elementary school students to professionals. These simulations were all created with the Visual AgenTalk language (VAT) employed by the AgentSheets system.

Introduction

In recent years, there has been much discussion about how technology can best be used to support learning. Computer simulations are one promising tool for supporting learning at all levels—from elementary school to workplace learning. Learners may create simulations in order to test hypotheses and explore ideas, or to communicate their ideas about a topic to others (Repenning, Ioannidou, & Ambach, 1998). Exploring simulations created by others exposes learners to ideas that may be different from their own, and gives them an opportunity to experiment with those ideas. Learning through simulations, either by creating simulations or by exploring existing ones, helps learners develop a deeper understanding of the concepts being simulated. A recent study by the Educational Testing Service (Wenglinsky, 1998) found that students in classes which used computer simulations to teach mathematics made significant gains on standardized tests, and scored significantly higher on standardized tests than did students in classes where computers were used for "drill and practice."

Learning about simulations is also important for lifelong learning. Simulations are frequently used as tools by scientists and policy makers. These simulations are based on simplified, imperfect assumptions. In order to be able to interpret and question these simulations, one must understand how simulations are constructed (Starr, 1994; Turkle, 1997). Working with simulations from an early age can provide a foundation for this sort of "simulation literacy."

In this paper, we describe a number of simulations that have served as tools for a variety of lifelong learners, ranging from elementary school students to professionals. These simulations were all created with the Visual AgenTalk language (VAT) employed by the AgentSheets system (Repenning & Ambach, 1996).

Elementary Schools: EcoWorlds

Current reform efforts in science education emphasize constructivist pedagogies (Yager, 1995)—approaches that place students at the center of the sense-making process and suggest that students learn by actively building their own understanding of a topic. One promising approach to meaningful learning and robust understanding of science centers on the creation and use of computer simulations as representations of how and why things work (President's Committee of Advisors on Science and Technology, 1997). Activities with simulations have the potential to help children organize, develop, test, and refine their ideas about science.

As part of the Science Theater/Teatro de Ciencias (sTc) project (Carlone, Garcia, & Lewis, 1998), we have developed a number of activities with simulations for elementary school students. The EcoWorlds curriculum for 4th and 5th graders is the culmination of three years of research on how children can build simulations of scientific phenomena, first using Cocoa (Brand & Rader, 1996; Cypher & Smith, 1995; Rader, Brand, & Lewis, 1997), and later Visual AgenTalk (Lewis, Brand, Cherry, & Rader, 1998). EcoWorlds focuses on a number of content areas, including characteristics of organisms, structure and function in living systems, populations and ecosystems, and diversity and adaptations of organisms. The unit addresses these issues by having students work in small groups to create computer simulations of ecosystems in different environments such as the Arctic or a desert. Activities with simulations are integrated into a curriculum which incorporates hands-on activities, research activities, and class discussions.

Students initially meet in small groups to discuss what types of animals might be found in their chosen environment. Each student then designs an imaginary animal which could be native to that region. The animal design must include adaptations for the animal to survive the temperatures common to its environment as well as to mate and to acquire food. Within each group, students collaboratively work out the predator-prey relationships for their ecosystems.

One group of students in the class decided to create an island ecosystem. Students created a food web for their ecosystem which included a bird, a reptile, and two amphibians. They designed their animals by first entering "features" for the animal and brief explanations of how these features helped the animal survive. Students generated their own ideas for features rather than choosing from a predefined list. For example, Laura's animal, the "purple whippy frog," is a small, plant-eating amphibian. Laura gave her frog a number of features to protect itself from predators, including fast legs to "get away from predators," poisonous skin to "protect itself," and slimy skin "so it does not get stuck." She also gave her frog some features which allow it to eat plants, including grindy teeth "to chew" and bacteria stomach "to help digesting."

Island EcoWorld with student-created birds, amphibians, and reptiles

Although they use a visual programming language (Visual AgenTalk) to create their animals, our primary goal is for students to learn about science, rather than to learn how to program. We have therefore modified the programming language extensively to make it more natural for students to express their ideas while maintaining a focus on the important science concepts (Rader, Cherry, Brand, Repenning, & Lewis, 1998).

In EcoWorlds, students "program" their animals using commands which relate specifically to the science content. When students create a new animal, they essentially fill out a form or "template" which provides the basic structure for the animal's behavior. These templates help them focus on the science content by taking care of the numerous non-science details which would be required to create an ecosystem simulation from scratch. The templates also provide constraints on animal designs by building in feedback. For example, an animal will die if it does not get enough food to eat or if the environment is cold and the student has not given the animal adaptations to survive the cold. Thus, students must think about science issues which otherwise might not have occurred to them.

The collaborative nature of creating an EcoWorlds simulation also pushes students to think more deeply about science concepts. Students were told that each animal must either eat or be eaten by at least one animal created by another student. In the process of negotiating the predator-prey relationships, students had to justify their ideas about their animals to one another. Because the predator-prey relationship is expressed as a conversation between two animals, students had to design the features of their animals to work together. In the island group, for example, the sharp beak of the Guglle-Buglle bird lets it eat the Squirm reptile egg, which has a leathery covering.

Once students had tested their individual animals, they performed experiments on their entire ecosystem to see whether all the species they had created could survive over time. An experiment in EcoWorlds consists of placing plants and animals into the simulation, running the simulation for some number of days, and observing changes in the populations of the different species. Elementary school students require assistance in order to be able to effectively experiment with simulations. The curriculum was designed to help students understand the goal of the simulation, as well as set up experiments, make and record predictions, run experiments, analyze the results, and make adjustments to the simulation based on experiments.

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The abstract concept that a change in a single plant or animal population may affect an entire ecosystem is a difficult idea for 4th and 5th graders. EcoWorlds makes this concept more accessible to students by offering them an opportunity to experiment with a dynamic visual model. Students were encouraged to think of different ways to set up their experiments. For example, some students thought it would be best to use the same number of animals from each species, whereas others knew that their ecosystem would require more animals of some species than of others.

Students often encountered unexpected results while running their simulations. They observed population changes, noting when a species became extinct or overpopulated, and were able to suggest ways to avoid these occurrences—varying the initial numbers of animals in the simulation or revising characteristics of their animals, such as their likelihood of mating or catching their prey.

Students were very engaged in this task, in part because of their identification with the animals which they created. They referred to their animals in the first person, saying for example "I'm dead" rather than "My animal is dead," or "I can eat you" rather than "my Ozzie can eat your Purple Whippy Frog." Because of this identification, students were very motivated to ensure that their animals survived. Although students initially had a tendency to want their animals to survive even at the expense of other populations, this tendency was often overcome once they realized that the other species were necessary for their animal's long-term well-being.

Our work with EcoWorlds has addressed some of the challenges we found in our previous efforts (Brand, Rader, Carlone, & Lewis, 1998; Lewis, Rader, Brand, & Carlone, 1997). In particular, by integrating the simulation activities with other activities (hands-on, research, discussions) and by modifying the software to be more content-specific, we have created a curriculum in which students are much more successful at creating their own simulations and in understanding the underlying science concepts. With the appropriate support, elementary school students can use simulations as a vehicle for new understanding and insight.

High Schools: The Grape Boycott

At the high school level, John Zola's students used simulations as part of the "Protest and Reform" history class at New Vista High School (Ioannidou, Repenning, & Zola, in press). In this class, students had an opportunity to study protest movements throughout U.S. history (e.g., the Civil Rights movement and the anti-Vietnam war movement), and to learn about theories of protest and social change. Initially, the teacher used "Segregation" (Schelling, 1971) and "Protest March" simulations created by researchers to present some basic ideas about protest and reform. Later in the course, students created their own simulations to present their thoughts and ideas for their final projects.

One of the groups that chose to do a final project using AgentSheets consisted of four girls who were initially intimidated by technology. They selected the topic of the California Grape Boycott in the context of the Chicano/a, Latino/a Civil Rights movement. The project, as the students defined it, included building a Web page which consisted of a boycott simulation applet which they had created, as well as links to related Web sites. The students intended their Web page to serve as a small virtual library on the subject.

The students realized that they needed to find out about the history of the boycott and of the United Farm Workers movement in order to begin building the simulation. They did some initial research in the library and on the Web to learn the basic historical facts, and found relevant Web pages which they referenced on their own Web page.

Once the students understood the basic facts about the boycott, they began to create their simulation. Presenting a complex social phenomenon such as the boycott without making the simulation overwhelmingly complex was a challenging project for these teenagers. Their first task was to choose a representative set of events that could be simulated. The students decided to illustrate the relationships among all the people involved in the boycott: farmers, workers, consumers, and worker organizers. Consequently, they created a simulation which represented individual people such as workers picking grapes, farmers that own the grape fields, consumers buying the grapes at the town's market, and Cesar Chavez influencing the consumers to participate in the boycott.

The process of building the simulation, running it, and observing the consequences led to new questions. When the students programmed the workers to get angry and refuse to work, the result was confusing. What really happened? How could there be grapes in the market when the workers were on strike? To answer these questions, the students went back to historical sources. They learned that when the Mexican and Filipino workers went on strike, farmers hired illegal immigrant workers. The students added information to their simulation in order to reflect this new piece of knowledge. In this case, building the simulation provided a focus for group discussion which pushed the students' ideas beyond their initial conceptions.

As these high school students developed the boycott simulation, they also created Web pages (http://www.cs.colorado.edu/~l3d/systems/agentsheets/New-Vista/Boycott-Project.html) containing historical information about the subject and links to related Web sites. These Web pages provide a critical connection between the course content and the simulation technology—a simulation consisting of brightly colored icons moving on a screen does not convey much meaning to its intended audience unless the creators of the simulation situate it in an informative context.

Collaboration also played an important role in this project. Initially intimidated by the computer, students found the task of creating a simulation less daunting when they all worked together, sharing ideas and helping each other out with the programming. The dual tasks of creating the Web site and building the simulation allowed members of the group to distribute the workload among themselves according to their individual interests. In this case, collaboration allowed the group to create a more complete project than any individual could have produced alone.

Creating simulations is a valuable experience for students when they use it as a way of story telling. Through this story telling, they gain a deeper understanding of the simulated subject. In the boycott project, the students had to learn about the history behind the Grape Boycott at a level of understanding that went well beyond that of typical high school projects. When building simulations, students do not have the option of mindless cutting and pasting of information as they do when they create a posterboard or a report. To create a simulation, students must form a deep understanding of the underlying principles of the topic. They must decide which aspects of a phenomenon or scenario are most significant and worth simulating. After discarding the less significant details, students must choose representations for the simulation actors and decide on rules which represent the behavior of individual actors as well as the relationships among actors. All these tasks demand a significant intellectual effort by students.

The high school students themselves became aware that creating simulations helped them learn about the boycott in a different way, as illustrated by their remarks:

> ***Clara**: "I didn't know anything about the boycott before. Having to apply it to the technology made me get into it more and understand it fully so that I could have it come out correct."*
>
> ***Teacher**: "More so or differently so than if you had created a posterboard?"*
>
> ***Susan**: "You had to know more because you couldn't leave out things. So if you didn't know everything you couldn't do it."*
>
> ***Stella**: "It's not like you can copy it out of an encyclopedia and put it on the posterboard."*
>
> ***Maria**: "It wasn't just boring writing stuff down; we got to interact with what we were doing."*
>
> ***Stella**: "[making the simulation] totally made you apply what you know towards like what you're doing!"*
>
> ***Susan**: "I took this class just for history; I didn't know it was gonna be anything with computers, but now that I did the whole computer thing, it's changing my daily life cause I used to hate computers and now I don't."*

Simulations Outside the Classroom: E. Coli and Prozac

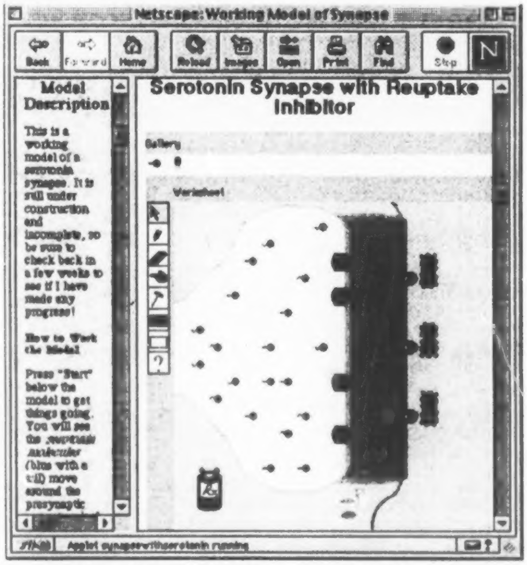
The value of building and using simulations is by no means limited to K-12 education; simulations are powerful tools for learning outside the classroom. Scientists create and use simulations both to explore and communicate complex ideas, as illustrated by the examples in this section.

Scientists often create simulations to help them test their hypotheses. Creating and experimenting with such simulations can give scientists new insight, help them revise their hypotheses, and help them predict the results of potentially expensive experiments.

In one example of this use of simulations, scientists at the BioServe Space Technologies have created a simulation of the behavior of E. Coli bacteria in low gravity settings in order to explore the implications of this behavior for fermentation biotechnology (Klaus, 1998). Scientists had previously found that fermentation occurred more quickly and with better results in space, but had not been able to explain why this is so. The goal of the simulation is to explain why E. Coli bacteria behave differently in low gravity situations such as aboard the Space Shuttle. Understanding the faster growth factor of bacteria in space may then allow pharmaceuticals to be produced less expensively in space than on earth.

Building this simulation has helped BioServe scientists to better understand the complex molecular interactions which take place during fermentation, and to explore ideas which could not easily be explored otherwise. The physical experiments which have taken place in the MIR space station and on several Space Shuttle missions are costly and need extensive preparation. By varying parameters, such as gravity, in the simulation, and by experimenting with differing amounts of substances such as E. Coli, scientists can use the simulation to select the most promising experiments to actually conduct in space. The simulation also allows scientists to simulate cases which are outside the range of what could happen in a physical experiment.

Working with simulations can also give scientists new theoretical insights. In one example, scientists found that the results from the simulation sometimes differed significantly from the results of the same physical experiment. This difference indicated a gap in scientists' theory of how the process worked. By analyzing the divergent data, scientists were able to add to their theory about E. Coli behavior—they hypothesized that the difference could be explained by the fact that E. Coli behave slightly differently when they reach the bottom of the test tube.


Netscape: Working Model of Synapse
Back
Forward
Home
Reload
Images
Open
Print
Find
Stop
N
Gallery
Varicosity
Applet synapsewithserotonin running

Model Description

This is a working model of a serotonin synapse. It is still under construction and incomplete, so be sure to check back in a few weeks to see if I have made any progress!

How to Work the Model

Press "Start" below the model to get things going. You will see the serotonin molecules (blue with a tail) move around the presynaptic

Serotonin Synapse with Reuptake Inhibitor

Simulation running in a Web page explains how serotonin works in the synapse and how antidepressants affect the system.

Scientists also use simulations as a way of communicating complex relationships to others. In contrast to the simulation described in the previous section, which was

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used primarily to explore effects that were unknown to its creator, simulations for communication are geared more towards simplifying complex dynamic processes in order to explain them to non-experts. Although simulations used for communication may not provide new insights to their builders, they can be a means to learn how to communicate about an area of expertise, or a tool, to help the expert clarify his or her own knowledge about a topic. Creating such simulations requires the builder to create realistic relationships among components of the simulation. This process may also illuminate the underlying assumptions held by the builder by impelling him or her to create concrete representations of the actors in the phenomenon being simulated, and to decide which relationships are most important. Thus, simulations which are designed to teach a set of concepts can provide learning opportunities for both their creators and their users.

SimProzac is an example of an interactive simulation used primarily for communication. SimProzac was created by a psychiatrist who wanted his patients to understand the effects of Prozac on the functioning of the brain. He decided to create an interactive simulation for his patients so that they could explore the relationships among Prozac, the neurotransmitter serotonin, and neurons, in a way that would not be possible by simply reading about these relationships. Users of the simulation can observe the relationship between serotonin and neurons in the absence of Prozac, and can release Prozac into the simulated synapse at their own discretion to observe its effect on the system. The psychiatrist has embedded his simulation applet in a Web page which includes a description of what occurs in the simulation. This Web page can be accessed at http://www.csn.net/~wphillip/Synapse_applet/synapse.html.

Conclusions

For both students and adults, simulations provide an opportunity to work with ideas. In the case of students, a simulation is most often a tool to grasp ideas which are already "known" to the professional community but which are difficult to understand. For adults, a simulation can be a tool to extend the current knowledge within a field. Both students and adults, however, follow a similar process when working with simulations—stating a hypothesis, devising and running simulation experiments, and analyzing the results. They both interact with ideas when they view and attempt to explain simulation results, especially when the results are unexpected. Students who create their own simulations share with adult professionals the additional tasks of deciding what factors are most important and how to represent their understanding of the simulation topic.

Working with simulations can promote collaboration among learners because the simulations are concrete and can be manipulated and discussed. The results of a simulation experiment may yield several different interpretations, which can be discussed within a group of learners. Determining how to respond to the simulation results (e.g., how to get a species to survive or how to show why grapes were still available) can be a shared creative process. The exchange of ideas among group members can enhance the meaning that learners derive from the simulation activities.

Interactive simulations accommodate a range of engagement for learners, depending on the level of interest and amount of time available. When time is limited, users may simply observe simulations created by others. The educational benefits of this type of situation are probably similar to watching an educational video clip. In a more time consuming but educationally richer mode, learners may run some number of experiments with pre-created simulations. This type of activity allows learners to explore a topic by comparing and contrasting different scenarios. When time permits, users may get a deeper exposure to the subject matter by modifying parts of an existing simulation or even building a new simulation from scratch. By working with simulations in different ways and on different topics, learners acquire the "simulation literacy" necessary for a better understanding of the purposes and limitations of simulations, and are then better able to use simulations as a tool for lifelong learning.

Acknowledgments

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General Session: Technology Implementation

Putting It All Together: Transforming Schools through Technology Integration

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Key Words: **professional/staff development, technology planning, evaluation, assessment, training, research, best practice, instruction**

This session brings together the "tools" that enable schools to realize improvements in teaching and learning as a result of strategically integrating technology. Research-based resources, information, and the practical wisdom collected by the six federally-funded Regional Technology in Education Consortia will be shared. Resources are many and varied but include: professional development strategies, courses, and resources for teachers and leaders; technology planning that includes staff, students and communities; assessment instruments and approaches; funding options and opportunities. Whatever you need—the RTEC's probably have. http://rtec.org/.

General Session: Teacher Education and Training

Designing and Developing Electronic Portfolios among Graduate Educators

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Key Words: electronic portfolios, multimedia, hypermedia, digital

This session will present the design, development, and publishing of professional electronic portfolios using various computing technologies among education graduates at Wright State University.

Wright State University has been extensively involved with graduate student portfolios for a decade. With the encouragement of the Educational Technology faculty, these culminating professional products have emerged as electronic portfolios. From the thick and more cumbersome three-ring folders of the past have sprung the electronic portfolios, providing increased interactivity, accessibility, and integration of various media elements documenting the skills of these professional educators.

The session will present a description of how portfolio creation and development fits into the educational curriculum of professional educators at Wright State University. Session participants will also see and explore examples of various electronic portfolios that were developed in past years. The session will also include explanations of the various computing hardware and software tools that students utilized beginning with the design process through the final publication.

Participants will be exposed to:

- a graduate curriculum that effectively integrates portfolio development among all students as their culminating experience to their formal education,
- design and development processes needed in the creation of effective electronic portfolios,
- the electronic tools needed to develop and publish electronic portfolios, and
- examples of a variety of professional portfolios developed by K-12 educators.

Presenters for this session bring with them an extensive background in educational technology. Dr. Bonnie Mathies serves as Assistant Dean for Technology in the College of Education and Human Services at Wright State University. She has been instrumental in developing Educational Technology and Library Media Master's Degrees effectively designing the curriculum integrating portfolio experiences for all graduates. Dr. Richard Clemens is Assistant Professor of Educational Technology in the College of Education and Human Services at Wright State University and past Director of the Instructional Technology/Multimedia Laboratory at WSU. Along with facilitating multimedia instruction, he also works closely with each graduate student in design, development, and production of their portfolios.

General Session: Computer Science

Preparing Students for the New Advanced Placement Examination Using C++

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Key Words: **programming, AP, Visual Basic, Java, computer languages, compiler**

May 1999, marked the first time the Advanced Placement Computer Science exam was based on C++ rather than Pascal. The changeover was marked by controversy and caused anxiety among many high school teachers. After several years of teaching C++ to high school students, however, it is clear that C++ as defined by the College Board can be effectively used in introductory courses.

Topics include:

- Steps programming teachers can take to help students avoid the traps inherent in programming in C++
- How Object-Oriented Programming relates to the AP curriculum, and how languages such as Visual Basic and Java can work in conjunction with C++
- C++ assignments and handouts to assist teachers with the implementation of C++ in the high school classroom
- A look at some released questions from the May 1999 AP Exam to give participants a sense of the approach taken in the exam
- How event-driven graphics can be used in a C++ course, and how this serves as a strong motivator for students

General Session: Curriculum and Instructional Strategies

Developing WebQuests to Support the Curriculum

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Key Words: **WebQuest, staff development, K-12 curriculum, Internet, training**

Kentucky strives to provide a strong support structure for Kentucky students and teachers in the area of technology integration. Professional development for Teachers is a priority in Kentucky. WebQuests have provided teachers and students a clear focus for instruction utilizing Internet resources.

In this session, participants will explore WebQuests developed by Kentucky teachers to support the K-12 curriculum. By first exploring sample WebQuests developed by Kentucky teachers, attendees will understand the concept of WebQuests and their value in the K-12 curriculum. Participants will discover a simple WebQuest about WebQuest. We have developed a step-by-step guide that uses screenshots and simple, easy to understand directions on developing a WebQuest using a template with Netscape 4.05. Participants will discover how simple developing their own WebQuest to support the curriculum can be, using a template linked to the Kentucky Department of Education's home page. In addition, participants will be supplied with numerous URLs that will support the development of their content-specific WebQuest. By using this simple guide and the supplied Web resources, each attendee can go back to their classroom and develop their own WebQuest specific to their own needs.

As an ISTE Leadership Academy graduate, Cornette has worked closely with educators from all over the United States on the use of technology and Web-based materials to support the curriculum. She holds an M.Ed. in Education and a Rank I in Instructional Technology from the University of Louisville. Creasy holds an M.Ed. from the University of Kentucky in Education. Presently, they are technology coordinators for the Kentucky Department of Education and have trained teachers and instructional technology leaders throughout the state of Kentucky in various uses of technology to support the curriculum. In addition, they have trained District Technology Coordinators and teachers within their regions on the use of Web-based resources to support instruction. As Kentucky Education Technology System

Coordinators, they are proud to be a part of the Kentucky Education Technology System and share a leadership role in training others on the use of technology to support instruction.

Research Paper: Social and Ethical Issues

A League of Their Own: Gender, Technology, and Instructional Practices

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Key Words: **gender differences, technology, student inquiry, Internet use**

Abstract

The study—funded through a Dwight D. Eisenhower Professional Development Grant—examined gender differences and the process of Internet-assisted inquiry in a single-sex, technology-enhanced environment. Five group case studies consisted of various configurations selected from a cohort group of students and teachers representing two city school systems, five county systems, and one private school. A qualitative approach to research was implemented using the constant comparative method of data analysis. Data in the form of observational field notes, transcripts of video tapes, artifacts, and photos resulting from a two-week summer workshop revealed interesting findings regarding student behaviors while interacting with computers in a single-sex environment. Results from the study indicate that female students—when interacting within a single-sex environment—display similar behaviors as male students do when engaging in technology-enhanced activities. Additional findings show that the classroom teacher, operating within a theoretical framework and personal educational philosophy, can either hinder or enhance student processes.

Margaret Mead (1971) believed that the ideal culture nurtured its members and made a place for every human gift. In his book, *Multiple Intelligences: Theory in Practice*, Howard Gardner (1993) suggests that the purpose of school should be to develop intelligences and to help each student reach vocational and avocational goals appropriate to their particular spectrum of intelligences. The theory of multiple intelligences is one of cognitive functioning. The theory proposes that all students possess eight intelligences—which range from logical mathematical to linguistic. If these intelligences are to be advanced, students must be given equal and ample opportunities to develop and achieve within a non-threatening classroom environment. Both Mead and Gardner's work speak to all students, however there is one group in the student population—the female student—whose intellectual gifts are not being addressed or nurtured to the degree that some feel they should. Pipher (1994) illustrates this point further when she quotes Stendhal as saying, "All geniuses born women are lost to the public good."

Initial research conducted by the American Association of University Women (1992) shows that girls in general receive an inferior education to boys. The report, *How Schools are Shortchanging Girls* (1995) reveals that girls receive less attention; are pursuing less math-related careers than boys; and in some cases are more likely to be rebuffed by teachers. It is these forms of subtle gender bias that are preventing girls from achieving and excelling in the areas of math, science, and technology. Although studies show that there are no innate differences in ability between men and women, a very significant difference can be traced in participation and achievement in these curriculum areas (Silverman & Pritchard, 1996). Caine and Caine (1994) point out that this may be attributed to specific brain functions that are employed while learning. Research conducted by Sonnert and Holton (1995) further support this notion. Their findings show that gender disparities in the field of science may be attributed to: a) *a deficit model* that says women are treated differently and b) *a difference model* that says women act differently. In addition, since learning is often influenced by emotions, teaching methods should connect, relate, and encourage innate abilities and interests (Belensky, Clinchy, Goldberger & Tarule, 1989; Caine & Caine, 1994; Silverman & Pritchard, 1996). When the results of the TIMSS (*Third International Math and Science Study*, 1997) became available to the general public, it became evident that girls were scoring slightly lower than boys were in the areas of science and mathematics. Nawaz (1996) and Pipher (1994) attribute some of this to the fact that many educators believe there are social pressures and cues early in life that steer girls away from these areas. In fact, not only do girls score traditionally lower on standardized science and math tests, findings indicate that girls view these subjects as "male dominated."

Research in the areas of gender differences, performance, and computers has not been as extensive as studies that examined gender differences with regard to performance in the areas of math and science. However, research that has been conducted shows that girls view the use of computers as a "male-oriented" activity (Yelland, 1998). Further findings reveal that there are definite differences based on gender with regard to performance and computer-oriented tasks (Craig, 1997; Hoyles, 1998; Hughes & Mac Leod, 1986). This body of research indicates that—when working with computers—boys appeared more confident in their problem solving abilities; were more likely to associate computing with a high level of academic ability; engaged in a type of parallel conversation while computing; and were more apt to share solutions and problems with other boys.

In contrast, girls were less confident in their problem solving abilities; engaged in conversations centering around the task at hand; were more apt to seek assistance from an adult rather than another student; and appeared more confident while engaging in online conversations via chat rooms (Craig, 1997; Hoyles & Sutherland, 1989). Furthermore, Schrof (1993) points out that differences such as these create a gender-sorting machine of sorts—one that needs to be dismantled in order to ensure that girls have the opportunities that everyone assumes they already have. Jane

Daniels, NSF gender equity advocate, reiterates this by making the statement, "How can we imagine, in this highly technical world, that our economy won't collapse if we fail to fully develop half of our nation's brainpower" (Schrof, 1993, p. 42).

Examining Single-Sex Environments and Computer Utilization

While initial research conducted by the AAUW (1995) appears to be common knowledge among the educators in public schools today, there remains a discrepancy between current practices and female students' attitudes and achievement in math, science, computer use, and test scores. Although an AAUW (1998) follow-up study indicates that there is not much difference in attitudes and achievement when female students are placed in a single-sex private school environment, prior research prompts several questions regarding the public school classroom such as: (a) Would the attitudes of female students regarding math, science, and computers change if given the opportunity to work within an all-girl environment? (b) Would female students behave the same as they would in a male-female environment if given the opportunity to engage in computer-assisted research within a single-sex group? and (c) What classroom implications, if any, would emerge from such a study that would assist classroom teachers in meeting the needs of this particular student body? These four queries acted as overarching themes for data collection throughout the study.

The study utilized these initial questions to examine, document, and provide a rich, thick, and dense description of how female students operated and interacted with each other and with teachers in a single-sex environment as they pursued research topics within a math and science framework. Using a qualitative approach outlined by Bogdan and Biklen (1992), the researcher became a participant observer in conducting five group-case studies consisting of female students and teachers representing Grades 5 through 8 from a purposive sample in a lab-type setting where they engaged in group inquiry with the assistance of networked computers, peers, teachers, and all other resources available on a university campus.

Data sets were collected through observational field notes of student-student interaction and student-teacher interaction, transcripts of video and audiotapes of each session, student journals, pre- and post-attitudinal surveys, media surveys, interest questionnaires, and a photo essay. The project, funded through an Eisenhower Professional Development Grant, was designed as a two-week summer institute for both teachers and students. The first week consisted of an awareness training workshop where teachers examined current research regarding gender differences, math and science achievement, and computer utilization, in order to design student inquiry project guidelines that incorporated math, science, and Internet resources. The student inquiry projects focused on topics in physical science, geometry, and measurement, that the teachers felt would be of particular interest to adolescent girls. Teachers then field-tested their materials with 5th through 8th grade female students during the second week of the project. Observations and data collection spanned the two-week period. Library and Internet access provided students with additional research material as needed.

Findings

In reflecting on the processes involved when conducting qualitative research, Eisner (1998) writes that vision depends upon the existence of qualities that can be seen—these qualities may be aspects of the world we inhabit or products of our imagination. Both the content of the world and the content of our imagination are dependent on these qualities. One of the initial questions that framed the study converged on how teachers would react to female students within a single-sex technology-driven environment. The question implied a focus on instructional practices as well as attitudes, which in turn have the potential to influence the learner. This focus emerged into a unique phenomenon that would drive the study into an alternative area.

In an attempt to offer insights into the milieu, general findings are presented in the chronological order in which they occurred—beginning with findings concerning students and progressing to findings concerning teachers. As data collection took place, the researcher recorded daily reflections as a means of gaining understanding as well as to compile a list of implications for classroom teachers. In addition to daily entries in an observational field journal, videotapes of each session provided additional information to aid in understanding the nature of transactions between students, teachers, and computers. Two graduate research assistants assisted the researcher in the process of collecting data. Entries from observational field journals were compared and used in the process of triangulation of data.

One the first day of the week-long session, students were asked to complete attitudinal surveys regarding their perceptions of science and math. The pre-workshop session survey revealed that 40 out of 52 participants felt confident in their ability in the areas of science and math. However, 48 out of 52 felt that science, math, and computers were very "male oriented" areas. Responses from the post-workshop surveys showed that when asked the same questions, all of the participants felt very confident while working with subject matter in science and math and in utilizing the Internet for research purposes. At the culmination of the week-long workshop, only half of the students indicated that math, science, and computers were "for boys" (Table 1).

Pre-workshop survey participant responses to "teacher influence" questions with regard to success in math and science indicated that the role the teacher played in the math and science classroom had a direct influence on students' perceptions of their abilities in these areas. Entries from observational field notes further indicate that at the beginning of the workshop, teachers had a great deal of influence on the success and performance of student participants. The following entries were recorded on the first day of the workshop:

Table 1. Student Responses to "Male-Orientation" Pre-Workshop and Post-Workshop Attitudinal Survey Questions #9, #11, #24, & #28

Question	Pre-Workshop Response	Post-Workshop Response
#9. It's hard to believe that a female could be a genius in math, science, computers.	48 = strongly agree 4 = disagree	26 = strongly disagree 10 = strongly agree 16 = agree
#11. When a woman has to solve a problem in math or science, she should ask a man for help.	48 = strongly agree 4 = disagree	20 = strongly disagree 6 = disagree 15 = strongly agree 11 = agree
#24. I would have more faith in the answer to a math or science problem solved by a man than a woman.	46 = strongly agree 2 = agree 4 = disagree	25 = strongly disagree 1 = disagree 6 = strongly agree 20 = agree
#28. Females are as good as males in math and science.	40 = strongly disagree 12 = disagree	26 = agree 26 = disagree

Note: Surveys were administered to 52 participants. Responses indicated are based on the following scale: *strongly agree, agree, disagree, strongly disagree*

> Researcher's Entry—Monday, June 8, 1998
>
> *"I'm nervous about presenting my project. I'm scared of messing up and having my teacher see me. She thinks I can't put this together as it is."*
> (student participant comment—informal conversation)
>
> Researcher's Entry—Monday, June 8, 1998
>
> *"She (teacher participant) thinks we can do this, so we better be good when we show her what we've done. Look (at project design form) what do you think? Will she like it?"*
> (two students' informal conversation while working on project design)

However, at the end of the workshop, only seven out of 52 student participants still felt that it was the teacher who influenced their perceptions about their ability and success when engaging in science and math activities (Table 2).

Table 2. Student Responses to Pre-Workshop and Post-Workshop Attitudinal Questions #30 and #26

Question	Pre-Workshop Response	Post-Workshop Response
#30. I feel math/science teachers ignore me when I try to talk about something serious.	52 = strongly agree	7 = strongly agree 40 = strongly disagree 5 = disagree
#7. It's hard to get math/ science teachers to respect me.	52 = strongly agree	2 = strongly agree 5 = agree 44 = strongly disagree 1 = disagree

Note: Surveys were administered to 52 participants. Responses indicated are based on the following scale: *strongly agree, agree, disagree, strongly disagree*

In addition to the attitudinal survey, students were asked to complete an interest-information survey before attending the workshop. After examining responses to the information survey open-ended question, "What type of profession would you like to strive for after completing high school?" the researcher compiled a list of student-selected career categories (Table 3). The categories—generated by student participants—were used to design a "media-enhanced" version of the original interest information survey. The new instrument incorporated pictures of media and film stars that represented the girls' career choices on television and in popular films. The media-enhanced survey was administered to the 52 participants, who were asked to select their top three career choices once again. The results were extremely different from the first set of data gathered regarding future careers. The top three career choices—indicating the power of the media—are displayed in Table 4. These findings indicated that the media certainly do have power in shaping young girls—physicians, scientists, and astronauts were no longer the top choices of the group, although previously stated on the original survey.

Table 3. Categories of Student Responses to "Career" Information Survey Open-Ended Question, "What type of profession would you like to strive for after completing high school?"

Category	Number of Students Responding to Specific Category
Physicians	22 students indicated "physician" as top career choice
Teachers	15 students indicated "teacher" as top career choice
WNBA Star	2 students indicated "WNBA star" as top career choice
Veterinarians	4 students indicated "Vet" as top career choice
Astronauts	2 students indicated "Astronaut" as top career choice
Scientists	3 students indicated "Scientist" as top career choice

(table continues)

Table 3. (continued)

Category	Number of Students Responding to Specific Category
Singer	1 student indicated "Singer" as top career choice
Model	2 students indicated "Model" as top career choice
TV Star	1 student indicated "TV Star" as top career choice

Note: Survey administered to 52 participants prior to attending workshop.

Table 4. Student Selected Career Choices—Media-Enhanced Survey

Career	Selected as "first"	Selected as "second"	Selected as "third"
Model—represented by Claudia Schiffer	27 students	19 students	6 students
TV Star—represented by Jennifer Aniston	18 students	21 students	13 students
Singer—represented by Mariah Carey	7 students	40 students	5 students

Note: Media-Enhanced survey administered to 52 participants. First, second, and third career choices are indicated.

The first major findings concerning students and their interactions with each other and with computers indicated that girls did behave very differently in the absence of boys. Prior studies conducted in male-female settings (Craig, 1997; Hoyles, 1998; Hughes & MacLeod, 1986) indicated the blatant differences between girls and boys as they interacted with computers.

In general, the single-sex group showed none of these differences. In the area of seeking assistance, female students sought help from each other first, then if all else failed went to an adult in much the same way that male students did in previous studies. Group preference—as indicated in findings from studies examining student behaviors in mixed gender settings—showed that boys favored working in groups of three or more while girls worked in teams of two or individually. Throughout the week-long summer session, however, female student participants—when given the choice—elected to work in groups of three or more.

While working with computers and utilizing the Internet for research, the conversation that took place within the groups of girls ranged from the project at hand to what they did the night before to family business. This was also similar to the conversation reported as taking place by male students in previous studies (Table 5).

Table 5. Topics of Student Conversation While Working at Computers

Number of Students in Conversation	Topic of Conversation
Group #1—6 female students from a suburban middle school	"Shopping at 'The Gap'"
Group #2—5 female students from a rural elementary school	"Being in college—living in a dorm"
Group #3—3 female students from a suburban middle school	"Phillips' Bookstore—MTSU campus"
Group #4—5 female students from a suburban elementary school	"Soccer versus basketball and hockey"
Group #5—three female students from a rural middle school	"Roller Coaster Project"

Note: Conversation Topics—recorded in researcher's observational field journal and gleaned from transcripts of videotaped session. Conversations took place as students were conducting Internet searches on their research topic—Computer Lab 101B.

Computer utilization was varied and went from on-again off-again use to constant duration of more than 60 minutes at a time. There was no one pattern that emerged as students designed projects, other than every collaborative project consisted of multiple components with one of the components being a computer-generated presentation or a product that was the result of an authoring program or a word-processing program.

Findings from observations of teacher and student interaction, however, were alarming, to say the least. Behavior exhibited by teachers has been categorized into three areas: (a) the dictators, (b) the inhibitors, and (c) the risk-takers. To further explain, teachers—when working with female students and computers—either dictated what students should do, inhibited student progress, or encouraged risk-taking and inquiry. For example, videotaped transcripts show teachers lining students up in a computer lab as they proceeded to pace back and forth dictating when students should "click" to advance to another link, "scroll" down a Web site or "conduct searches." When working ahead, students were scolded, tapped on the hand, and were told to pull away from the computers—similar to being put in "time out." The following excerpts from the researcher's observational field note entries further support the findings indicated by the transcripts:

> Researcher's Entry—Monday, June 8, 1998
>
> *Two teachers telling girls what to do—teachers pulled their chairs up to the girls' chairs so that they were touching the back of the chairs. teachers proceeded to tell girls when to use the mouse. Teachers saying, "now go here" and "scroll down now" and "now read this."*

> Researcher's Entry—Tuesday, June 9, 1998
>
> *Two teachers (rural system) sitting with their girls and telling them what to do on the computers—"Type this here (pointing)" and "Go here now" and "Don't move on until I tell you."*

Although every participant—teachers as well as students—took part in initial training using the Internet, the dictator teachers also had previous experience working with the Internet prior to participating in the project. In fact, five of the seven dictator teachers were at the advanced or intermediate level with regard to Internet use.

Teachers exhibiting inhibiting behaviors virtually did all of the research for the girls and completed the projects while assigning the students menial tasks such as coloring letters or cutting out pictures downloaded from Internet sites. The inhibitor teachers all had previous experience using the Internet—conducting searches, downloading information, and utilizing resources for classroom use. Observational field notes indicated that the inhibitor teachers told students each day that students did not understand what to do, therefore the teachers would complete the projects for them as shown by the following entries in the researcher's field journal:

> Researcher's Entry—Tuesday, June 9, 1998
>
> *Teacher (to students)—"Go into the classroom and color the letters for the poster—I'll do the search and bring in some pictures for you to cut out. You really don't know what a project should look like, so that's (cutting) the best thing for you girls to do."*
>
> Interactions between one teacher and three students—suburban school system/Grades 7 & 8

The dictators and inhibitors combined consisted of 1 Caucasian male, 6 Caucasian females, and 5 African American females. Both the dictators and inhibitors represented a variety of backgrounds and school environments. The classroom experience of these 12 teacher participants ranged from 5 to 15 years—both beginning and mid-career. Perhaps the most interesting observations were those that involved the "risk-takers." This group of teachers consisted of 2 Caucasian males and 7 Caucasian females. Their experience ranged from 2 years to 23 years. The risk-takers represented a low-income rural school system, a suburban school system, an upper middle-class school system, and one private school.

The main characteristic that all of the risk-takers displayed was that they acted as facilitators by: (a) providing students with requested materials, (b) encouraging students to pursue interests, (c) encouraging students to utilize the Internet for information, and (d) supporting students as they designed projects that reflected their personal styles. The computer and Internet experience of these teachers ranged from the beginner to the advanced user. The variety within this group indicated that the behaviors exhibited related more to personal educational philosophy than to experience, background, technological literacy, or income (Table 6).

Table 6. Profile of Teacher Participants and Categories—Dictators, Inhibitors, and Risk-Takers

Teacher Classification	No. Years Experience	Computer Use	School
Dictator #1—Caucasian Female	23 years	Advanced	S-RCS
Dictator #2—Caucasian Female	15 years	Intermediate	S-RCS
Dictator #3—Caucasian Female	12 years	Intermediate	S-RCS
Dictator #4—Caucasian Male	25 years	Intermediate	S-RCS
Dictator #5—Caucasian Female	5 years	Advanced	S-RCS
Dictator #6—Caucasian Female	17 years	Intermediate	R-FCS
Dictator #7—Caucasian Female	19 years	Intermediate	S-LSS
Inhibitor #1—AA Female	6 years	Advanced	S-LSS
Inhibitor #2—AA Female	9 years	Advanced	S-LSS
Inhibitor #3—AA Female	21 years	Intermediate	S-MCS
Inhibitor #4—AA Female	23 years	Advanced	S-MCS
Inhibitor #5—AA Female	10 years	Advanced	R-WCS
Risk-Taker #1—Caucasian Female	24 years	Advanced	S-WCS
Risk-Taker #2—Caucasian Female	21 years	Beginner	S-WCS
Risk-Taker #3—Caucasian Female	5 years	Beginner	S-WCS
Risk-Taker #3—Caucasian Female	8 years	Intermediate	S-WCS
Risk-Taker #3—Caucasian Female	5 years	Advanced	P-FRA
Risk-Taker #4—Caucasian Female	2 years	Intermediate	R-FCS
Risk-Taker #5—Caucasian Female	5 years	Advanced	R-FCS
Risk-Taker #6—Caucasian Male	12 years	Beginner	S-LSS
Risk-Taker #7—Caucasian Male	17 years	Advanced	S-LSS

Note: Coded as follows: AA = African American; S = Suburban; R = Rural; P = Private School; Location code is followed by school code for school system or school site (LSS; MCS; FCS; FRA; RCS; WCS; WCS)

Conclusions and Implications for the Classroom

The project offered students opportunities to engage in inquiry pursuits within the areas of math and science while utilizing Internet resources and working in a single-sex environment. Referring back to the overarching questions that provided a framework for the study, the attitudes of the students did seem to change from the beginning of the study to the culmination. Analysis of female participants' responses to the attitudinal post-workshop survey showed that girls had changed their perceptions regarding the previously stated "male-dominated" world of math, science, and computing. In addition, responses from a post-workshop evaluation seminar, which involved all student participants, revealed that out of 52 girls, all of the elementary school-age participants (35 participants in Grade 5) preferred female-only groups. However, all 52 participants also indicted that within the classroom setting—if given the choice—they would select group members differently depending on the task at hand—sometimes selecting female peers, other times selecting a combination of males and females. These findings offer the first implication for classroom teachers. By using a variety of grouping techniques within the classroom and by varying the members—sometimes giving females the opportunity to work exclusively with other females—teachers can provide further avenues for girls to succeed in math and science environments.

In the area of technology-enhanced single-sex learning environments, female participants' behavior indicated that group preference, work habits, and conversations were similar to that of male students described in previous studies conducted (Craig, 1997; Hoyles, 1998; Mac Leod, 1986). A second classroom implication is offered based on these findings. The "computer talk" and conversation that takes place while students conduct Internet-assisted research appears to be essential to the inquiry process. By considering and encouraging preferential work patterns, project design, and peer to peer conversation, teachers enable students to pursue inquiry interests within their own framework of learning.

Although teacher participants attended gender-differences awareness sessions, most did not seem to utilize the information gained from the sessions during the project. In fact, the dictator and inhibitor teachers seemed to hinder the process as girls engaged in technology-assisted inquiry. Post-workshop evaluation responses indicated that teachers planned to provide opportunities for students to engage in Internet-assisted inquiry, however further responses revealed that teachers did not feel that they treated female participants any differently than they would have if participants were males. Teacher responses extracted from the project evaluation instrument are as follows:

> *"I'm planning to use the research process in my algebra class."*
>
> *"I treat all students the same—I treated the girls the same as I always do."*
>
> *"I would treat boys the same way—they all act the same in the classroom."*
>
> *"I don't see any difference—same as what happens during the school year."*

Findings imply that data is inconclusive in the area of teachers and awareness of the gender differences that occur within the classroom setting. Perhaps, additional training sessions and insights into the process of practitioner and action research would be helpful in assisting teachers as they continue to observe mixed-sex classrooms. The awareness sessions conducted at the onset of the study may not have been conducted at the degree of intensity needed for the teacher participants to make any permanent attitudinal changes.

There was no set pattern in terms of the teacher's level of computer use—beginner, intermediate user, or advanced user—and the manner in which they assisted the female students. Teachers reacted in a variety of ways when assisting students with technology. Behavior, however, seemed to be based more on educational philosophy than on computer experience. Unfortunately, the current media seem to indeed have a direct influence on how girls perceive their futures and careers as indicated by the results from the media-enhanced survey administered to the student participants. The addition of pictures of the television and film stars influenced career choices to the point that every participant selected a combination of the same three careers—as represented by stars—for their first, second, and third choices. These findings support previous studies conducted by Pipher (1994) and offer several implications for classroom teachers including: (a) be aware of the degree of influence the media has on female students, (b) incorporate non-traditional examples of careers found within the media in order to assist female students as they examine their choices, (c) provide strong role models within the local community to counteract what the media offers female students, and (d) engage female students in discussions regarding career choices and alternative careers that they may express interest in.

If educators must meet the needs of all students and encourage them to reach their fullest potential, classroom teachers must become aware of not only the differences between male and female students, but also that an awareness-based attitudinal change must take place. This change—in combination with an examination of media influences that are attacking young females—must be taken into consideration by every teacher who has been charged with the education of more than half of the nation's future workforce. However, this alone will not assist our young girls in drawing on their inner or true self, as described by Pipher (1994). Teachers must also examine their own philosophical framework. If traditions combined with popular culture are driving these educational philosophies and the way females are viewed within the classroom setting, then an even bigger threat is present. Educators—whose attitudes have a direct impact on the female learner—must assume a leadership role in assisting this endangered population by: (a) truly examining their educational philosophy, (b) revising that philosophy to meet the needs of young girls in the classroom, (c) assessing common attitudes towards the young female, and (d) downplaying media influences in an attempt to assist girls in meeting success. To quote Maggie Ford (1998), president of the AAUW Educational Foundation, "As student diversity changes the face of public education, and technology changes the workplace, schools must work smarter and harder to ensure that girls graduate with the knowledge and abilities they need to compete and succeed in the 21st century economy."

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Society Session: Staff Development

Staff Development 101 ... Revised for the New Millennium

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Key Words: **staff development, teacher training**

When it comes to staff development, creativity is the key. Although training sessions and workshops are commonly used for technology staff development, little can be successfully applied without creative follow-up and supplementary activities. Staff Development 101 ... Revised for The New Millennium will examine innovative characteristics for staff development, diverse models and methods of delivery, and some fun ideas—some high tech and some not—for staff training sessions. We will provide at least 101 ways to motivate reluctant staff members to begin using technology. Project samples, program ideas, and encouraging plans will be included.

Real Thinking: Group Problem-Solving Experiences for Middle School Students

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Key Words: **critical thinking, group problem solving, anchored instruction, integrated curriculum, school-to-work, simulations, middle school, preservice teacher training**

Teachers often struggle to find creative ways to integrate the middle school curriculum and make learning experiences engaging and realistic for their students. This presentation is based on group participation in a lesson simulation that focuses on critical thinking skills for the workplace and models curriculum integration, based on principles of learning theory.

Using technology to support anchored instruction and group problem-solving techniques, can help teachers communicate the interrelatedness of all content areas and show their students how what they learn in school is relevant to the workplace. Promoting real thinking in the middle school classroom can be easy and fun with the help of laserdiscs, bar-coding software, and simple desktop-publishing applications.

Topics include:

- Using simulations to promote critical thinking skills
- Addressing all learning styles with technology-enhanced instruction
- Technology-based integrated curriculum
- Demonstration of technology-based anchored instruction
- Group problem-solving activities in preservice teacher training programs
- Designing alternative assessment measures with laserdisc technology
- Laserdisc technology and educational products
- Creating and using bar codes to enhance instruction

Emerging Media for Distance Education: Mentoring, Shared Design, Virtual Communities

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Key Words: **distance education, virtual communities**

The development of the Internet is creating new media for distance education, such as the World Wide Web and shared virtual environments (e.g., text-based virtual worlds such as MOOs). A medium is in part a channel for conveying content; as the Internet increasingly pervades civilization, learners and educators can readily reach wider, more diverse audiences. Just as important, however, a medium is a representational container enabling new types of messages (e.g., sometimes a picture is worth a thousand words). Emerging representational containers for distance education, such as virtual reality, make possible a broader, more powerful repertoire of pedagogical strategies. Also, new media empower new types of experiences; for example, interpersonal interactions across networks can lead to the formation of virtual communities.

The innovative kinds of pedagogy empowered by these emerging media, messages, and experiences empower an evolution of synchronous, group, presentation-centered forms of education—traditional teaching by telling into alternative instructional paradigms. In particular, distance education is moving beyond "talking heads" and Web-based textbooks to collaborative learning-through-doing. New tools and pedagogies for mentoring, shared design, and virtual communities offer the potential to create shared "learning-through-doing" environments available anyplace, on demand. Through a mixture of instructional media, learners can experience synchronous or asynchronous interaction, face-to-face or in disembodied form or as an "avatar" expressing an alternate form of individual identity. In other words, emerging media enable an extraordinary range of cognitive, affective, and social "affordances" potentially of great power for learning while at the same time having very definite limits for expression and communication.

Much study is needed to develop the new kinds of rhetoric necessary to make these emerging media effective for learning, as well as to design a mix of media appropriate for a specific group of learners, a particular content, and a given set of educational goals. A course on distance education I recently taught enabled a pilot exploration of these issues. (Access to the course syllabus and materials is available through my Web site at www.virtual.gmu.edu/EDIT611/syllabus.htm) Thirty-one graduate students in instructional technology completed the course and manifested an extraordinary range of preferences to the six instructional media used: face-to-face interaction, videoconferencing, synchronous interactions in a text-based virtual world, archival Web sites, groupware with a shared design-space, and asynchronous, threaded discussions.

Several Initial Findings are Intriguing

1. Students exhibited very different preference patterns for the six ways of expression and communication used in the class; lively debates ensued among those who liked and hated particular instructional media.
2. The extensive "no significant differences" studies comparing instructional media (e.g., correspondence courses vs. face-to-face instruction) seem flawed in that the average performance of a group is compared for single-mode delivery media. In a course using several instructional media with different characteristics (e.g., synchronous vs. asynchronous, high-bandwidth vs. low bandwidth), all students can select the most effective ways of empowering their individual learning, leading to better average performance of the group.
3. Students appreciate the richer, more inclusive types of interchange that result in an asynchronous medium. Many learners find a "voice" they lack in face-to-face settings, and everyone has a chance to say more when air time is not limited. However, this deeper educational experience consumes more time and is less social than classroom settings, leading to mixed feelings despite a sense of having learned more. Also, students felt this type of learning experience called into question the seat-time-based methods by which educators quantify the amount of learning and determine a sufficient level for graduation.

These results offer considerable promise for improved educational outcomes and for the transformation of conventional instructional settings.

General Session: Computer Science

Computer Science Education in the Secondary Schools: Reexamination of Curriculum and Teaching Certification Guidelines

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Key Words: **computer science education, curriculum guidelines, certification issues**

Computer science is widely recognized as a discipline in the post-secondary education community and as a profession in our society. However, computer science education remains a fragmented, misunderstood subject area in the K-12 educational sector. The reasons are many and complex. The current movement of education reform, exemplified by the implementation of national and state content standards, has ignored computer science as a discipline. This is but one symptom of the problem. Whereas there is a movement towards a K-16 seamless transition in science, mathematics, and language arts; and engineering and technology education is being extended from the university level to the elementary and secondary grade levels; a state of confusion at the pre-college level still exists in the discipline of computer science. Post-secondary education should be complementary to the high school education, and must build upon what has been previously learned. This can be accomplished only by appropriate articulation.

Professional organizations in both education and computing have recognized the existence of this problem and have developed recommendations for secondary school computer science curriculum. However, dissemination remains slow and not systemic. The curriculum is a necessary step towards a recognized subject area, as is the need for well-trained teachers in the classroom. Most computer science teachers still come from the ranks of inservice teachers. Professional development, of course, is an ongoing process. The recognition of the discipline of computer science in the schools should be advanced at the same time as two other important issues: (1) a certification and/or endorsement process for current teachers of computer science and (2) the establishment of preservice programs for training future teachers. Currently, most computer science programs reside either in the mathematics, science, technology or business departments, with teachers certified in various areas. The problem is reflected in the lack of core content standards development and the lack of teacher certification in the discipline.

One other issue needs to be addressed: There must be a distinction between the technology and the computer science curriculum. In one perspective, computer science must be considered as subject matter and technology should be viewed as a tool that cuts across all subjects. For example, technology is used as a tool in mathematics, in science, in social science, in English, and in other disciplines, including computer science where primarily the computer is the tool. Therefore, within the context of this discussion computer science is a subject matter as opposed to a tool: the computer is the tool and computer science is a discipline that uses it, naturally, among other tools.

Although little organized dissemination has taken place, efforts to promote computer science education in K-12 schools and to advocate for teacher training programs has taken place since the 1970s. There are many schools that offer computer science programs but not many students choose to take it; in most schools, computer science remains an elective subject. There are many questions that need to be considered in order for computer science education in the secondary schools to be enhanced. For example, what are the courses that make the computer science program? What should be taught in these courses? Where do the topics come from?

New Jersey Institute of Technology (NJIT) has convened conferences on Computer Science Education in the Secondary Schools since 1995 in order to address some of the major issues underlying the problem, the implications, and suggestions for possible solutions. The overwhelming response to these conferences is a clear indication that the articulation problem between high school programs and those at the university level is a critical issue for secondary school educators. Attendees of this general session should expect discussions on students' and teachers' needs, reports on previous work to improve computer science education, and the issues learned from the NJIT conferences, as well as a presentation of curriculum guidelines formulated by classroom teachers.

General Session: Technology Implementation

Teacher Leadership in Technology Change K–12

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Key Words: **teacher leadership, administrators, change**

This presentation focuses on the leadership role our staff had in creating a National Blue Ribbon school. It also outlines how our district has empowered teachers to take on leadership roles in implementing technology integration throughout our educational system.

Description

This presentation will outline how our school acquired and set up a robust computer network, computer labs, computer presentation systems in every classroom, and a video production program through grants, donations, and creative budgeting without a tech levy. I will discuss how we implemented schoolwide integration of technology into the curriculum and provided the training necessary for all staff members to be successful. Participants will be given concrete examples of integration strategies and models, creative equipment acquisition methods, and training materials.

The presentation will also cover how our school district has adopted our model of teacher leadership in the implementation of our technology bond. For example, our entire technology training program has been developed and staffed with classroom teachers from each of the buildings in our school district. This not only provides our instructors with firsthand knowledge of the issues, needs, and abilities of our training clients, but it also gives them the flexibility and immediacy to create effective, real-time training. Another example of how teachers have been empowered in this process is the decision making model. Teachers have formed technology committees at each of the buildings and compose the District Technology Committee, with the power to make major purchasing and policy decisions. Participants will walk away with a model of teacher leadership and decision-making that can be used throughout their school system.

Experience

For the last seven years, I have taught middle school math, science and art. My integration of technology into all areas of the curriculum and my ability to teach others earned me the opportunity to develop and facilitate a yearlong technology training program for our middle school staff. Based on the success of this program, I was asked to develop the training materials, coordinate the training schedule, and lead the training cadre during the districtwide staff development process for the next two years.

As a classroom teacher, I earned the Seattle Times Teacher of the Year Award in 1998 and the Leaders in Restructuring Award from the Washington State Education Association in 1997.

General Session: Curriculum and Instructional Strategies

Video Production: From the Dumpster to the Deluxe Studio

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Key Words: **video, equipment, resources, fundraising, community service**

This presentation covers how to set up a video program if you have a budget of $100 or $100,000. I will discuss equipment, resources, fundraising, program organization, and projects. I was selected as a Seattle Times Teacher of The Year for my "creative facilitation" of this program and my "Dumpster diving."

Description

This presentation will provide participants with the basics to start a video program regardless of their experience or budget. It will start with the humble beginning in a closet of our school and lead them through the evolution of the state-of-the-art production studio we now work in. I will show how to maximize their limited resources to acquire equipment through grant writing, donations, and junk shopping. I will also discuss how to tap into the resources available in the community, on the Internet, and within their own schools.

Participants will walk away from this presentation with curriculum integration ideas and strategies. Our program is completely run by students, with a focus on community service. We run a morning broadcast every day, complete with school information, news, sports reports, and highlights of student activities. One of our primary missions is community service. Some of the projects we have produced include a video child identification program, public service announcements, and filming of local events. We are currently working on a toy drive in which we raised over $5,000 worth of presents last year and a documentary of an archaeological site under excavation. Participants in this presentation will be amazed at what this program and these students have accomplished.

Experience

For the last seven years, I have taught middle school math, science, and art. My integration of technology into all areas of the curriculum and my ability to teach others earned me the opportunity to develop and facilitate a year-long technology training program for our middle school staff. Based on the success of this program, I was asked to develop the training materials, coordinate the training schedule and lead the training cadre during the districtwide staff development process for the next two years.

As a classroom teacher I earned the Seattle Times Teacher of the Year award in 1998 and the Leaders in Restructuring Award from the Washington State Education Association in 1997.

General Session: Curriculum and Instructional Strategies

Our Own Piece of the Planet: A Science/Technology Collaboration

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Key Words: **multimedia, science, curriculum integration, collaboration, K-4, small learning communities**

This project is a collaborative effort between three strands of our school community. As participants in a national science experience directed by the American Association for the Advancement of Science, sponsored locally by the Franklin Institute Science Museum with generous support from UNISYS, we developed this project to facilitate collaboration between the science and technology programs, with participation from the classroom teachers. Through the use of a LAN within our building, a WAN for World Wide Web resources, and hands-on science exploration, this collaborative project brings together the classrooms in an environment of sharing and cooperative learning for teachers and students.

In the science lab, students study earth science concepts through hands-on experiments. Topics include studies of the atmosphere, geosphere and hydrosphere, as well as topics related to the changes in our surrounding neighborhood ecology. Each grade group focused on a specific topic: kindergartners explored the seasons and their relationship to our neighborhood; first graders looked at air and water; second and third graders explored geological features and properties of rocks; and fourth graders focused on properties of rocks as well as volcanoes and earthquakes.

Classes in each small learning community explored one aspect of our community that relates to their small learning community theme. The themes include math/science skills for life, self-esteem, and a Native American thematic unit.

In the technology lab, students used World Wide Web resources, including a program developed by the computer teacher which utilizes "push technologies," to research related concepts, gather additional data, and participate in virtual field trips. As a final project, they brought together their accumulated findings to create multimedia presentations. Using Kid Pix Deluxe to generate QuickTime movies and slideshows, they demonstrated their understanding of newly learned science concepts, utilizing multimedia tools. The QuickTime movies and slideshows were then used to create HyperStudio stacks and Web pages. We published our work on the World Wide Web and on our LAN.

Continuing in the second semester, fourth graders are extending their studies of earth science to the solar system. In collaboration with a science methods program at Temple University which focuses on constructivist teaching methods, the technology curriculum supports the solar system theme being developed in the classroom. Students will use their understanding of animation, combined with the tools in MicroWorlds, to create interactive simulations of specific planets and earth habitats. We strive to provide open ended, constructivist environments in which students can explore and apply their new computer skills, while gaining a sense of confidence and understanding in using new technology resources.

General Session: Teacher Education and Training

Impact Project: Facilitating Effective Integration of Technology in Mathematics Education

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Key Words: **mathematics, technology, teacher education, preservice, inservice**

The Center for Technology and Teacher Education at the Curry School of Education is currently funded to develop materials to help preservice and inservice secondary mathematics and social studies teachers learn to incorporate technology into their teaching. The mathematics group is focusing on developing activities that will prepare teachers to use technology to enhance and extend students' learning of mathematics.

Thus, the mathematics materials are being developed according to the following guidelines:

- Introduce technology in context
- Address worthwhile mathematics with appropriate pedagogy
- Take advantage of technology
- Apply mathematics topics
- Incorporate multiple representations

The goal of this session is threefold. First, we want to discuss the above development guidelines and demonstrate several of our activities developed to date. Second, we will discuss how we use these materials in our preservice secondary mathematics methods classes. The third goal of our session is to engage participants in a discussion of how these materials could possibly be used in other secondary mathematics teacher education programs.

The activities developed thus far utilize The Geometer's Sketchpad, Microsoft Excel, MicroWorlds (logo), and graphing calculators. The Sketchpad activities address standard secondary school topics (e.g., Pythagorean Theorem, angle bisectors), as well as others (e.g., infinite series, Witch of Agnesi, Escher tessellations, golden rectangles, and art). Similarly, the MicroWorlds activities cover a range of topics, from typical (e.g., polygons, reflections, and rotations) to less common (e.g., Koch's Snowflake, the Four Color Conjecture, Sierpinski Polygons). The Excel activities focus on graphical and statistical analysis of real data (e.g., smoking and lung cancer, sunspots and magnetic disturbances, temperature), recursion (e.g., Fibonacci series), and simulations (e.g., probability distributions, projectile motion). The graphing calculator activities include graphing (e.g., solving equations graphically, piecewise graphing, Taylor's theorem), data analysis and modeling (e.g., temperature data, AIDS data), statistical inference (e.g., polling data), recursion (e.g., Fibonacci series), and simulations (e.g., growth of money, projectile motion).

The activity guides and several interactive projects written in MicroWorlds and Microsoft Excel are available at the Curry Center for Technology and Teacher Education Web site for viewing and download at http://curry.edschool.virginia.edu/teacherlink/act/impact/math/web/lnk_about.htm.

General Session: Computer Science

Providing Feedback to CS Students: Some Alternatives

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Key Words: **computer science, pedagogy, student feedback, grading**

Grading student work is a discouraging task. Students seem only to pay attention to the score I give the work. Also, providing feedback takes a significant amount of time. By the time students receive the feedback it has lost much of its relevancy since they are working on the next assignment. This increases the likelihood that students will pay little attention to it. I want to reduce the time I spend grading while maintaining student performance at present levels (or improving their performance).

When I realized that, as computer science is not the same as programming, teaching is not the same as telling, I finally began to make progress at improving my teaching. I now search for principles to guide my teaching. One principle is that if I wish students to learn to do something, I must have them do it. Furthermore, and most critically, everything we want students to learn should involve "doing." "Appreciate," "understand," "know," and other verbs commonly used as educational outcomes are of little use beyond playing Trivial Pursuit. Students have become quite adept at regurgitating the things we tell them. They seldom apply them. If we want students to be able to test their own programs we should have them develop test data and test them, not just run programs on our test data or "know" what "white-box" and "black-box" testing mean. If we want students to write good programs, we must not only inform them of the characteristics of good (and less good) programs, but we must have them actually evaluate programs.

As I begin relying more heavily on having students do things in order to learn, I must be much more conscientious about providing them feedback. They must know whether their performance needs improvement and, if so, where the improvements need to occur. It is also very important that the feedback occur in a timely fashion. My past grading practices clearly did not meet both these goals. I could provide good feedback or timely feedback, but not feedback that was both good and timely. I recognized a need to do something different. The difference had to occur in the teaching rather than in the grading.

Currently, I am attempting to incorporate into my teaching (in-class actions) activities that can provide students timely feedback on their own or someone else's work. I am also making significantly more use of group work. While I have performed no formal study to determine the efficacy of these approaches, they certainly are much more theory-based than my previous approach and I feel significantly better about them.

The things I have tried as mechanisms for providing timely feedback on student work include:

- Telling less and responding to questions more in class activity. Having students do more means they have more questions. Responding to questions makes student involvement more active.
- Discussing or critiquing samples of student work in class. Students volunteered their work for discussion and I chose items that seemed most productive to discuss.
- Having students work in groups. Group work can be applied in most classes.
    a. Group work can serve several informal purposes. I requested the groups review individual work prior to grading. Some groups have extended their activity to include study groups outside class.
    b. I also use groups more formally. Individuals bring their work to the group and the group uses it to submit a single solution for grading. This cuts grading by 50%-75%, significantly reducing grading time and making feedback more timely. I sometimes have students submit their individual work, but only check that it was done. Other alternative grading formats could also assess individual effort or ability. This works

very well if students have a good attitude and take responsibility for learning.

- Checking work in class. I randomly call on individual students for their solutions to exercises. Other students check their own work and ask questions when uncertain of its correctness. The called-on students receive grades while everyone receives feedback. (I have only used this in discrete structures but could use it with any content requiring practice exercises.) I supplement in-class checking with frequent quizzes which can be graded quickly.

I am continually looking to refine these activities and to incorporate new ones that I encounter. It seems clear to me that I am on the right track for improving my teaching.

General Session: Computer Science

Stress-Free Programming

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Key Words: **curriculum and instructional strategies, team teaching, computer science, programming**

Learning how to program a computer can be an overwhelming experience for any student. If that student is not a computer science major, it can seem impossible. For the last two years, we have been experimenting with new teaching strategies to make the learning process easier for preservice teachers, inservice teachers, and other beginning programmers.

The first change in the introductory programming course was to incorporate technology directly into the classroom by changing from a three-hour lecture format to two hours lecture and two hours hands-on lab per week. This format lead naturally to the next shift in teaching strategy: team teaching. One teacher lectures and the other teacher supervises the lab. Both teachers plan lectures, laboratory activities, programming assignments, and tests.

Response by students to the new teaching strategies has been extremely positive. The hands-on lab assignments allow the students to learn by doing, not just seeing. In addition, the students have a teacher in the lab to give direct assistance. The team teaching method allows students to hear the same information in slightly different ways from two sources. These advantages are particularly beneficial for preservice teachers who generally have little or no programming experience, may be math and techno phobic, and are intimidated by the process of learning such a new subject.

Currently, preservice teachers take the same course as computer science majors. Beginning with the Fall 1999 semester, preservice teachers and other non-computer-science majors can elect to take a separate course. This change should alleviate most of the stress that derives from taking a class with computer science majors.

Attendees will gain insights into an effective strategy for teaching beginning programmers. An outline for a 15-week course will be shown. Sample labs will be provided. Sample programming assignments will also be available. University faculty, high school teachers, and teacher trainers will benefit from this session.

Presenters are both faculty members at Northeast Louisiana University. Dr. Virginia Eaton is certified to teach English, mathematics, and computer science. She has taught at the middle school, high school, and university levels. Currently, she is an Associate Professor of Computer Science. For the past three years, she has directed a teacher enhancement project funded by the National Science Foundation. This project included teaching inservice teachers to program in several different languages. Mrs. Taylor is an instructor working on her dissertation in computer science. Both she and Dr. Eaton teach a variety of programming courses to both undergraduate and graduate students.

General Session: Curriculum and Instructional Strategies

Science, Math, and Related Technology: Teaching an Integrated Course

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Key Words: science, mathematics, integrated technology, middle school

SMART class (Science, Math, and Related Technology) is a course that teaches sixth graders spreadsheets, graphing, Internet searching, and software applications while integrating content from their science and math courses. Created and taught by science and math teachers, SMART was developed in response to our need to enhance our technology offerings for sixth graders. Prior to the creation of SMART class, sixth graders' technology experience was limited to a weekly LOGO class as part of their math course and occasional visits to the computer lab as part of their regular science course. SMART now allows students 40 minutes of computer contact time in addition to their regular math and science class time.

SMART class enhanced our math curriculum by replacing a somewhat outdated LOGO course with more current technological applications. Science class benefited by having one additional period per week of reserved computer contact time. The success of this course has led our middle school to revisit its entire approach to technology, and there is widespread enthusiasm for the overhaul of the seventh grade computer course to integrate not only science and math, but all disciplines.

Topics presented will include:

- Microsoft Excel spreadsheet activities emphasizing entering and sorting data, using Function Wizards, using Chart Wizards, and creating graphs
- Interactive Internet activities that integrate math and science
- Software applications that integrate math and science
- Ideas for further integrating math, science, and technology
- Practical information on scheduling, assessment, preparation, and logistics

General Session: Curriculum and Instructional Strategies

Technology with a Spanish Accent

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Key Words: **world language instruction, computer-generated materials, software, Internet**

Over the past 27 years, especially as each September approaches, I ask myself, "How am I going to teach the same topics and skills over again?" Finding and utilizing new materials and methods is a constant mission. Incorporating the special effects of computer technology into my teaching has provided me with a whole new avenue to explore.

This workshop, via a PowerPoint presentation, is designed to encourage and motivate world language instructors to integrate computer technology in order to enhance teacher effectiveness and peak student interest. This demonstration will benefit teachers with varying computer skills and computer access, whether it be one computer at home or in the back of the classroom, or a number of computers in a lab situation.

The presentation is divided into four parts: organizational materials, teacher-made materials, computer software, and Internet use. Part one, organizational materials, will demonstrate how time consuming teacher tasks can be done more quickly and effectively via the computer. Participants will view templates to facilitate maintaining a planbook and substitute schedule; charts and graphs to help track student and class performance; spreadsheets to record information for student trips and grades; and various ways to use slide show presentations.

Part two, teacher-made materials, will demonstrate several types of activities and worksheets that optimize student learning and achievement. Examples include templates of bingo cards, school schedules, and verb charts.

Part three, computer programs, will demonstrate software applications that can be used by teachers and students individually or in a lab situation. Participants will be shown examples of computer generated visuals used for classroom instruction, demonstrations, games, and bulletin boards.

Part four will demonstrate how the Internet can be used by teachers as an educational resource and instructional tool.

A booklet composed of presented templates and a list of Internet sites will be distributed.

General Session: Staff Development

Creating Teachers Who Use Problem-Based Learning and Technology

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Key Words: **staff development, problem-based learning, integration, curriculum, organization, research, presentations, technology as a tool**

This model of staff development takes teachers through a problem-based learning experience using technology tools throughout the process. It establishes easy ways to begin doing problem-based learning and to use technology seamlessly in the process. Teachers both experience and analyze this process, as well as link it to their own classroom.

The session will cover the above class in detail with diagrams establishing a simple beginning format for PBL as well as linking technology to it. A specific example of this process will be given in detail, by computer, with hard copy available. This example is easily adapted to other school districts. It has been the model used in LaGrange School District 102 for three years and has proven to change teachers' attitudes about technology, and increase their use of technology with students. Students learn how to use technology appropriately when it is needed for organization, research, and presentation of material.

The course described above is the first of five technology staff development courses structured to help teachers integrate technology into curriculum using problem-based learning. All courses will be outlined to provide an overview of the entire technology staff development program.

The first course is an overview and deals with technology integration, management, and problem-based learning. It is followed by an Organization class in which teachers learn how to use the computer to organize information while writing activities for students in which technology helps organize information. A Research class and two Presentation classes follow, using a similar format.

The activities teachers write are often guided by a district adopted list of minimal grade level technology experiences that teachers must give students. All activities are shared so teachers have vast amounts of activities that easily and appropriately fit into curricula.

Attendees will leave with many ideas of how to incorporate technology into problem-based learning, and how to implement a similar staff development program.

Research Paper: Technology Implementation

BEN:LINCS: A Community Model for the Pennsylvania Education Network

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Key Words: **community network, Internet, Link-to-Learn, microscopy, library, history, music**

Abstract

BEN:LINCS, a Pennsylvania Testbed Project, attempts to demonstrate a sustainable model that supports network-based educational activities among schools, homes, libraries, museums, and local cultural organizations.

Project Educational Goal

In 1997, the Commonwealth of Pennsylvania elected to fund 14 out of over 200 proposals to develop models for the future Pennsylvania Education Network. The BEN:LINCS Project was funded as a Technology Testbed Link-to-Learn Project to develop (over a two-year period, 1997–99) a community-based educational network model which might be transferable to other communities. Link-to-Learn is the name of Pennsylvania's educational technology initiative. Key criteria were that the network should be economically and technologically sustainable after the close of the project funding. BEN:LINCS stands for the Bethlehem Education Network: A Local Instructional Network for Culture and Science.

The building of community-based networks has been closely monitored ever since the Blacksburg Electronic Village (www.bev.net) prototype. BEV began out of 1992 discussions among Virginia Polytech, Blacksburg and Bell Atlantic, and its growth has coincided with the growth of the World Wide Web. The Initial model of BEV was to provide high-quality network access throughout their Appalachian community. To do that it created a centralized model—a central office and organization—to provide connectivity and to maintain the community network. That office was projected to cost about $200,000 per year, of which 90% was staff cost. The BEV model has been successful, in part, due to support from major organizations such as Bell Atlantic and VPI, significant grant funding, and a central office and staff.

In spite of the BEV's strong model, it appears that most community networks have not been able to enlist similar financial and organizational support. A national organization founded to support community networks, the National Public

Telecomputing Network (NPTN), filed for bankruptcy in 1997. It emphasized the "Free-Net" model that evolved in Cleveland in the electronic bulletin board days before the Internet. Free-Nets emphasize "free" connectivity to the community network. I would suggest that the popularity of the Internet and the increasing availability of low-cost, high-quality Internet service has undermined the basis of most Free-Nets as it has undermined NPTN. Some recent community-based networks have been "school-centered," focusing on achieving school objectives through associations with other schools and with the community (e.g., Becker and Hunter, 1998). Others have focused on building the required Internet infrastructure (Gusky, 1997) or on networking disadvantaged communities (Wells, Bowlin, Callaway, Champagne, & Quebodeaux, 1998). Some, like KC-Net and FoxNet (Gusky, 1997), have focused on networking the larger social players such as hospitals, local government, social agencies, and libraries to local schools and universities. BEN:LINCS had a different focus—to put some of our local cultural, historic, scientific and educational resources on the Web for the benefit of our students and our community.

The BEN:LINCS project envisioned a community-based network of local educational resource providers. In the same way that the Internet provides access to international resources, BEN:LINCS would help local organizations make their educational resources available over the World Wide Web. BEN:LINCS would be composed of a group of partners, each a provider of information resources rather than a consumer of resources—partners such as local libraries, museums, and historical societies. Highly motivating learning activities would be developed that were relevant to the community and that could engage students in school or at home. This network could strengthen the bonds among schools, families, and the community.

The BEN:LINCS Project was designed to use seed money to help each partner develop a Web presence of educational resources and activities. Standard Internet technologies and protocols were selected in order to base the network on inexpensive, easy-to-support technologies. Each organization's core mission and current staff were to be leveraged to provide the educational services they wished to provide, but through a new medium, the Internet. This design required neither long-term organization nor new permanent staff, and each organization would have the continuing motivation to maintain their educational site as an economical way to reach their target audience.

The Project and Its Partners

BEN:LINCS was a partnership among Lehigh University, the SMART Discovery Center (a local science museum), the Bethlehem Area School District, the Bethlehem Area Public Library, Historic Bethlehem Inc., the Moravian Museum (a local historical museum), the Bach Choir, and the Moravian College Music Department. After it was funded, the Project gained the support of Winnebago Software Company and Apple Computer as corporate partners. The project co-directors were from the Bethlehem Area School District and from Lehigh University. The school district co-director was to handle educational and operational tasks, and the university co-director was to handle finances and institutional liaison. The award was granted to Lehigh University as the fiscal agent.

The BEN:LINCS Project sought to provide information-rich links to exemplary curriculum-focused regional resources. Building on existing networks such as the Internet, the Lehigh University Network, and Bethlehem Education Network (BEN is the school district network), the BEN:LINCS partnership proposed a series of 10 projects that would create network-enabled activities designed to motivate and empower students and their teachers. The projects would use current Internet standards and the unique expertise of the Project Team to leverage existing world class local resources in science, history, and the arts to world class learning resources that can serve as a model for larger educational networks, such as the Pennsylvania Education Network.

The 10 projects were arranged into three logical groups as described below: SMART Net, Local Library Web, and Close-To-Home Curriculum. Individually, some of the projects, such as SMART Telemicroscopy or SoftSEM, offered remarkable educational opportunities within their discipline. Together, however, the BEN:LINCS projects permit us to glimpse a future network that provides powerful learning opportunities on any topic from any place at any time to any person of any age. This future network would enable students to actively explore knowledge at their own pace; to collaborate with experts, mentors, peers, teachers, and mentees; and to create projects that not only cross traditional subject boundaries, but combine relevant kinds of media that appeal to individual and multiple learning modalities. It is this vision that drove and directed BEN:LINCS, and it is this vision that should drive the Pennsylvania Education Network.

A. SMART Net is a group of five projects that involve the SMART Discovery Center (SDC—now named the Discovery Center) and Lehigh University's Electron Microscopy Laboratory.

   1. SMART Telemicroscopy will allow students to explore over the Internet a three-dimensional microworld with a scanning electron microscope in much the same way that they now navigate through underwater wonders with Dr. Robert Ballard of the JASON Project.

   2. SoftSEM will simulate over the Internet the operation of a scanning electron microscope. Students will use SoftSEM to explore exemplary previously photographed specimens and to learn how to operate the SMART Telemicroscope.

   3. SMART Link will be a fiberoptic cable that will connect SDC to Lehigh University to support very high bandwidth activities between the two sites, including dramatic telepresence activities such as the JASON Project in the SDC's JASON Theater.

   4. JASON Outreach will be an educational Web site devoted to involving students with the JASON Project on a long-term, in-depth basis.

   5. Hands-On-Science Web will be an educational Web site devoted to furthering the SDC's principles discovery learning through manipulation of a microworld of concrete science materials. A series of engaging home and school activities will be created that introduce, explore, and expand the hands-on exhibits at the SDC.

B. Local Library Web will provide a Web-based means to contact and search all local library catalogs over the Internet. Patrons can search several library catalogs with a single interface and a single search.

6. The Bethlehem Area Public Library will connect its automated library system to the Internet through a security firewall to provide Web-based catalog access and open-standard searching of multiple library catalogs (z-39.50).
7. The Bethlehem Area School District Libraries will update 3 school libraries and automate 12 more to provide a total of 16 school libraries with the capability of searching their catalog over the Internet from student homes or from any classroom, and the capability of open-standard searching of multiple library catalogs.

C. Close-to-Home Curriculum will provide highly motivating, network-enabled activities using local history, music, science resources, and organizations.

8. The Interactive History of Local Technology and Industry project will begin the process of making a wealth of regional history available in engaging Internet-enabled learning modules. The Lehigh Valley and the City of Bethlehem occupy unique positions in the history of American technology and industry. For example, Lehigh County was once the leading producer of iron ore, slate, cement and potatoes, and Bethlehem had an Early American Industrial Park before the Revolutionary War! The project will begin with learning modules of sites that are important to that history.
9. Bethlehem's Living Musical Heritage will begin a similar process to capture on the Internet the 250 years of rich musical history in the City of Bethlehem, including distinctions such as the oldest continuously performing musical organization in America and the first violin and viola made in the United States.
10. Planetarium Online will be an online high school course designed for students to learn astronomy in the same way that scientists study astronomy: collaboratively over the Internet in a project-based environment.

Implementation Issues

Implementation of BEN:LINCS has been underway for almost two years, and in that time issues have surfaced that may be generic to any similar project. During that time we have seen that some of our original approaches appear to work and that some had to be modified. This is information that could be valuable to any community-related education project.

1. LEADERSHIP. A few key people determine the success of this kind of project. The Project Leaders must be dedicated to the task. The support of the leaders' parent organization is essential, and secretarial help is valuable. Neither the BEN:LINCS leaders nor their organizations were paid for their

time. It was the dedication of the leaders to educational and community ideals that would make it work, or not. While any permanent project staff may appear to be a strength and may help the project start, that staff can become a liability when the funding stops. Sometimes a permanent staff winds up dedicated to a perpetual search for outside funding. It was the BEN:LINCS vision that the long-term success of the project should not depend upon continued funding beyond the start up period.

2. VISION. It is the leaders' job to build a shared vision among the partners to identify their common community and educational goals. Organizations and individuals will work hard to further their own goals, but not to further those of someone else. Communication and trust are desperately needed to help organizations work together who are not used to working together. It is common for small organizations to be highly independent and parochial until they realize how the larger project will help them. For example, BEN:LINCS found that most community organizations genuinely want to help students and many have explicit educational missions. But the organizations will not work wholeheartedly on the project until they realize that the site also has promotional value for them.

3. STAFFING. BEN:LINCS tried to use only existing staff, volunteers, and a very few paid teachers and/or webmasters to carry out the project. All of the larger organizations were able to carry out the project with no additional staff. The smaller community organizations, however, needed help. It quickly became clear that two distinct kinds of skills were needed: (1) domain knowledge about the organization and its treasures, and (2) technical knowledge about computers, networks, and Internet. It turned out to be impossible to find anyone with the requisite domain knowledge (e.g., knowledge of photos of Historic Bethlehem) other than the current busy staffs of the small organizations. These people needed to be compensated for their time. This will remain a dominant issue as the project continues.

Technical staffing was covered by volunteers, community service high school students, and graduate students. It is possible that start up, paid, technical staffing would have been helpful, but the project could be put at risk if such a key person leaves or when the money runs out. It seems that the problem of adequate technical staffing is easier to resolve than the problem of adequate domain-knowledge staff. Many people in the community have the requisite technical skills, but the domain-knowledge is very, very scarce. One problem to be expected of the technical stall is that of maintaining a high level of quality and aesthetic attributes of the Web sites.

As the project develops, talented individuals may be attracted to the project. For example, a retiring music professor discovered that the BEN:LINCS music goal was one that he had been striving toward for his entire professional career. He decided to devote himself to that goal in his retirement. Community and educational goals strike deep chords in some people who may be willing to commit tremendous energy and competence to this kind of project.

4. TECHNOLOGY. A conscious decision was made to use inexpensive, easily available, empowering technologies that support Internet protocols over the

World Wide Web. All of the projects except telemicroscopy use asynchronous protocols (like Web and e-mail) so the activities are available anywhere, any time. A decision was made to favor technologies that do not require an attendant operator or specially skilled additional staff. The Telemicroscopy project is an exception to this decision because a microscopy assistant must be present at the remote site. This implies that a synchronous protocol such as teleconferencing must be used to communicate between the user and the operator.

The basic technology for developing educational activities was the Web site. Interactivity was provided by JavaScript and QuickTime VR, both freely available for any kind of computer. Collaboration is provided through standard Internet e-mail and forms technologies. The project chose other well-established technologies such as ethernet LANs over copper, fiberoptic WANs, and well-supported library automation and Web-publishing solutions. In general, these technologies have proven powerful enough to revolutionize higher education and business on a worldwide scale, and they would appear to be powerful enough to build the Pennsylvania Education Network at a minimal initial cost and with minimal ongoing maintenance and staffing costs.

BEN:LINCS assumed that the Internet infrastructure is or will shortly be in place, and it assumed that the building of that infrastructure is the province of utility companies from whom economical service may be purchased. Thus the hardware and network budget could be quite minimal if we assumed the existence of good transport media. It seemed wise for the project to focus on the creation of information and educational activities rather than on maintaining a telecommunications infrastructure. This assumption is probably a good one in urban areas and a poor assumption in rural areas.

Server space was shared by the participants. Since a new Web site does not need a large amount of storage, and since the small organizations do not have server administration expertise, it made sense to share existing Web servers rather than to purchase, set up, train personnel, and maintain new ones. The school district made space available on their Web servers for the historical and musical organizations. Apple Computer donated a Web server to the Discovery Center because they had a resident Webmaster (a position that was subsequently eliminated due to budget cuts!)

5. CURRICULUM/EDUCATION. In the first two years of BEN:LINCS, a collaborative infrastructure was built which can be put to educational use. Pilot educational activities and resources are nearing completion. The next phase of the project is the sharing of these models with the partners and the development of the model activities by a wider group of people. Building a Web-friendly Internet presence for each organization is a long job, and any educational payoff cannot come until the infrastructure is ready. Any similar project should be aware that the start up times may be much longer than originally anticipated (as BEN:LINCS discovered!)
6. CHANGE. The project suffered critical personnel changes (a co-director moved out of the area), organizational changes, and technology changes. It

is necessary to expect changes and to expect to accommodate them. For example, the SMART Discovery Center was totally reorganized with a change of name, mission, board, administration, location, and most staff! The software to put library catalogs on the Web was a problem due to the rapid change of technology. The Dynix library system of the public library underwent two significant releases to provide this capability. The public library is now on the Web, but not all features are working in the current software release, and they have not yet begun to implement the z39.50 protocol to make their catalog compatible with those of other catalog search engines. The school libraries benefited from the generosity of the Winnebago Software Company, whose software was selected to automate all school libraries. The Web component of the Winnebago Spectrum system was announced three years ago but has yet to be shipped. We found that this delay is not unusual for new software capabilities.

We expect that eight out of our original ten projects will be successful and that they will continue to grow under the auspices of their parent organizations. Any similar project needs to expect changes and needs to be flexible enough to accommodate them. Accurate time projections are impossible, and to expect close adhesion to a timetable is probably counterproductive.

The Future of BEN:LINCS

It seems clear that each of the BEN:LINCS partners will continue to develop their Internet presence. It also seems clear that each partner will develop that presence according to its own priorities, and that this development will provide additional information and services to the community. The big question that remains is the development of high quality educational resources by each partner. It is difficult to produce high quality educational activities. It was difficult to find individuals with the appropriate blend of skills to build pilot activities. I suspect that the school district may have to continue to provide leadership in this area. BEN:LINCS will continue to try to develop the model community-based and network-based educational activities that it originally proposed.

Summary

BEN:LINCS was designed to be a replicable model that any community can follow. It provides a powerful vision of how all of the education stakeholders in a region can collaborate to share resources or provide educational experiences to children at school and at home. BEN:LINCS resource providers included the school libraries, the public library, the university, and several local museums and cultural organizations. The BEN:LINCS model can be replicated using the unique resources that every region has. Every region has its libraries, its historical and cultural organizations, and its schools, which can collaborate to strengthen the educational experience of each child as well as strengthen the fabric of the community.

Two significant questions remain that BEN:LINCS was designed to have answered but has not: (1) Can such a project run successfully without a central organization and staff? and, (2) Can community organizations, in collaboration with school districts, develop high quality, Internet-enabled educational activities? The two-year

BEN:LINCS grant was enough time to build the infrastructure and the working relationships, but not enough time to build the educational activities.

Although community resources and money may be scarce, the BEN:LINCS model suggests that extensive technological resources may not be necessary to begin a community education network; the only critical need is for basic Internet connectivity. The BEN:LINCS model also suggests that it may not be necessary to hire expensive full-time staff. The BEN:LINCS vision is to integrate technology into the EXISTING fabric of the community rather than to add an expensive layer of technology bureaucracy on top of the community. It remains to be seen whether the BEN:LINCS model will be a successful model for other communities to follow.

Presentation and handout material are available at http://www2.beth.k12.pa.us/projects/ben_lincs/pres.html.

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Electronic Literacy Pre-Kindergarten through 12th Grade

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Key Words: **electronic literacy, Web-site evaluation**

Discover how one school system's concern for student and staff understanding of Web site evaluation skills led to an extensive Web site devoted to Electronic Literacy Pre-K–12.

Topics include:

- searching strategies
- using search engines and directories effectively
- evaluating Web sites
- citing online sources
- teaching staff strategies to help students stay on-task and safe on the Web
- organizing and training groups of teachers and media specialists to contribute to the Electronic Literacy Pre-K–12 Web site
- sharing lessons and pathfinders written by teachers and media specialists to integrate curriculum with electronic literacy skills

General Session: Curriculum and Instructional Strategies

Integrating the Internet into Classroom Instruction—Strategies to Enhance Existing Curriculum

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Key Words: **Internet projects, Internetized lessons, curriculum enrichment, teaching with the Internet**

This presentation will focus on how to use the Internet as a tool to enhance classroom teaching. The "Internet Style of Learning" is helping teachers and students change the approaches to teaching and learning. This presentation will discuss and demonstrate how teachers can take one of their "traditional" lessons and turn it into an "Internetized" lesson using resources from the Internet, or take a topic being taught and create a collaborative inquiry-based project than can be shared with a class in another location, nationally or globally. In addition, participants will learn how to use the Internet to find resources for lesson and project creation.

You will also learn how to meet hundreds of teachers from around the globe. Why not learn how you, too, can meet them! There are so many ways that teachers around the globe are using the Internet to "bring the world into the classroom." Examples of many projects and collaboratives will be demonstrated and presented. Examples of "content-based" Web sites will also be explored.

Most traditional lesson plans can easily be enhanced by adding Internet activities. These activities can include research exercises, communication with other students or experts, virtual field trips, publishing, collaboration, interactive activities, or Internet searches. It's always good to have students use the search engines that are designed for students (www.yahooligans.com) or www.ajkids.com (Ask Jeeves for Kids). Teachers can learn a lot from each other when they join listservs. Many teachers have already created lessons that include Internet components, so we should take the time to view such lessons.

Some teachers find it better to start with new lessons when including Internet activities into their lessons. They use their "traditional" lessons as outlines for their new lessons. It can take a long time to create the new lesson. Time has to be spent searching for the "right" site for the lesson. Once the site has been chosen, the next procedure is to develop some meaningful activities for students to complete when they visit the site. If the students are going to communicate with other students/experts, make sure they understand time zones and realize that they won't get responses immediately. Once students are proficient in using the Internet, they can do scavenger hunts on the Internet to find information. Of course, it's a good idea to try out the lesson before teaching with the Internet. Be aware that there might be technology problems so always have a backup lesson. WebQuests are always a good way to get started with "Internetized" lessons—http://edweb.sdsu.edu/WebQuests/webquests.html.

Once Internetized lessons become the norm for teaching, Internet projects should be the next step. Such projects should include students collaborating with other classes to exchange data, share writing activities, and create discussions on topics of interest. In addition, mailing lists often post requests for participation in hundreds of Internet projects. There are many commercial projects available for those who prefer to "buy in" to a packaged project.

What is a project? Projects are collaborative, interactive learning activities that allow students and teachers to interact with each other to carry out a research activity that supports the existing curriculum in new and exciting ways. Students use the Internet's research, communications, and publishing tools to get involved in data exchanges, team writing projects, world explorations, and even global shopping. The classroom walls become invisible as students connect to global partners and experts via the Internet. Through such projects, students around the world work together, sharing the experiences, research, and learning resulting from their work.

Ideas for projects come from students and teachers, and projects vary as widely as the people participating in them. Some projects consist of writing assignments, which are then posted to conferences and eventually gathered into a publication. Others consist of art projects, in which students from different schools exchange works of art. Still others provide ways for students to get directly involved in helping to solve problems in other countries.

Projects are usually organized according to the age/grade levels of the participants and by curricular subject matter. Participation is open to either students of all ages, primary/elementary students, or intermediate/secondary students. Subject areas include environmental or natural sciences; social studies, politics, and economics; arts and literature; language-based; and other/interdisciplinary.

Projects have been classified in a variety of ways. I*EARN (www.iearn.org), The Global SchoolHouse (www.gsn.org) Judi Harris (www.esu3.k12.ne.us/institute/harris/Harris-Activity-Structures.html) and Bernie Dodge (http://edweb.sdsu.edu/webquest/webquest.html) have made outstanding contributions to the use of

Internet projects. For example, I*EARN has categorized projects as structured, unstructured, and Learning Circles. Judi Harris has done extensive research in the area of Internet projects. As a result, she has classified projects into the following categories: Online Correspondence and Exchanges, Information Gathering, Problem Solving, and Competitions.

What follows are some suggestions and helpful hints in getting started with Internet projects.

Suggested Design Criteria for Internet Projects

While teachers try to accomplish a variety of activities during their classroom instruction, it is possible to achieve many of the following goals when implementing Internet projects into the regular classroom curriculum.

Internet projects should:

- focus on getting students to use their minds well;
- raise "real" questions and allow students to do authentic work rather than exercises;
- develop instruction around the questions, ideas, and concerns of students;
- recognize and use learners' purposes for learning;
- view learning as meaning-making and constructive rather than passive reception and regurgitation of transmitted information;
- develop active approaches to learning and encourage students to express their ideas and opinions;
- give students ownership of their learning;
- view teachers and students as co-investigators—both should seek knowledge and solutions to problems;
- foster collaborative/cooperative learning and devise activities that help build a sense of community;
- view students as producers of knowledge and publishers of their work;
- provide moments when everyone takes time to reflect on what they have learned;
- contribute to understanding of other nations and cultures;
- strengthen students' literacy and academic skills; and
- provide ample opportunity to strengthen students' technology and Internet skills.

The Internet can make teaching and learning exciting while encouraging students to become lifelong learners, contributing members of society, and valuable members of the world of work. The research, communications, and publishing skills learned by students through Internet activities are essential for now and the future. I have been on the Internet for 11 years. I often ask teachers who aren't using the Internet, "How are you accessing information? How are you communicating? How are you teaching?"

General Session: Technology Implementation

Turn on the Power of Multimedia and Language Arts

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Key Words: **multimedia, language arts, early intervention, primary grades, anchored instruction**

Little Planet Publishing, in cooperation with Vanderbilt University, created a multimedia approach for the development of language arts skills in young children. Based on research at the Learning and Technology Center at Peabody College, the principles of "Anchor Instruction" are incorporated in the use of print, video, laserdisc, audio CD, and CD-ROM for the acquisition and enhancement of listening, speaking, writing, reading, and higher order thinking skills.

Working within the context of an Anchor Story, participants can comprehend how multimedia can be used effectively in presenting a story, sequencing the story (story boarding), recording the retelling of the story, and writing and reading the story. By using the metacognitive hints, participants will perceive how a deep comprehension of a complex story can be achieved.

With an interactive multimedia approach, participants will understand how children can be creative and conversely reinforce spelling, reading fluency, and word attack skills. The colorful graphics, engaging stories, and flexible design will allow children to see and hear themselves as authors and readers.

Participants will have the opportunity to experience and understand one of the most highly awarded programs published for the primary grades.

Topics covered:

- The versatility of multimedia and the adaptation to the younger student

- The use of the Anchored Instruction approach to teaching language arts to young children
- Using a variety of media effectively and integrated to promote the development of oral language, writing, and reading skills
- Research from Vanderbilt University, Learning Technology Center creating authentic products to the acquisition of literacy skills

General Session: Distance Learning

Students' Distance Learning Delivery Dilemmas

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Key Words: **distance learning, student problems, Web course, technology, Web course design**

When faced with the prospect of developing a distance learning course, many educators believe the development phase is the most cumbersome part. Decisions need to be made regarding the type of bulletin boards and chat rooms to be used, the design of Web pages, layout of course materials, and many other factors. In reality, the development phase is challenging but not as difficult as the actual delivery of the course. When students interact with a developed Web course, the problems begin.

The general session will cover the dilemmas and problems students encounter when participating in a Web-based course. Problems related to e-mail accounts, bulletin board posting, formats of Web course designs, submission of assignments, and academic integrity will be presented. Possible resolutions to these problems will be outlined, including ways to avoid these problems in the development phase of the course.

Student concerns usually are neglected when course design and implementation occur. This may be more evident with distance learning courses since the instructor and students do not experience face-to-face interaction. The presentation will help attendees focus on problems students face with Web-based courses. An awareness of students' needs, problems, and concerns prior to Web course development may be instrumental in alleviating problems which will occur during the delivery of the course.

General Session: Exhibitor

Connecting People with Possibilities

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Key Words: networks, network computing, Internet, training, staff development, Java, student-centered instruction, teacher productivity, curriculum technology integration, collaboration, Web-based curriculum, research, classroom management techniques, grants

How does network computing facilitate student-centered instruction, impact student outcomes, and promote teacher productivity and collaboration? How can an entire school with limited digital technology and 50% novice computer users gain expertise and begin to create dynamic lesson plans that integrate networking tools? Sun Microsystems, in collaboration with Hillsdale Year-Round School and a team of consultants, have spent the past year exploring these questions and more. Utilizing Sun products, a unique staff development model, and Sun employee volunteers, much has been learned. The results of this pilot project will be shared.

Topics to include:

- Creating a vision and plan for effective technology, curriculum integration
- Access and equity
- Role of network computing in creating exceptional learning, teaching strategies
- Innovative training methodology and staff development model

- Tips for leveraging community, volunteer support
- School culture and change process
- A comprehensive Web site that includes research, training manual lesson plans, and valuable resources for classroom management, staff development, and integration of Java-enabled software and Internet in K-12 curriculum

General Session: Curriculum and Instructional Strategies

Debriefing Activities Using Web Sites

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Key Words: **debriefing, Web sites, Internet, classroom use**

The session will describe effective strategies for using educational Web sites. Debriefing techniques will be emphasized using a variety of content-related Web sites. Debriefing strategies are extremely useful methods for integrating information and activities associated with the Web. Panel discussions, role playing activities, critical evaluation techniques, simulation, comparing and contrasting methods, and using a visual summary represent some of the most important debriefing techniques used in education. These problem-solving follow-up strategies maximize learning from using the Web in the classroom. Debriefing is often referred to as the "missing link" in the technology integration process. The elementary and secondary school levels will be used to illustrate the debriefing process. In addition, math, science, and social studies Web sites will be included in the report. Matching characteristics of Web sites to specific debriefing strategies will be carefully examined in the presentation.

Topics Include:

- An overview of specific objectives included in the session
- A brief description of debriefing which will highlight the history and the instructional value of the construct
- Specific debriefing strategies linked to specific characteristics of educational Web sites
- Examination of compare and contrast, critical evaluation, simulations, visual summaries, and other methods

- Review of science, math, and social studies Web sites
- Evaluation of debriefing activities using Web sites
- Advantages and disadvantages of using Web sites

General Session: Curriculum and Instructional Strategies

Curricular Innovation with Collaborative Network Initiatives

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Key Words: collaboration, Internet, curriculum development, network communities

The Collaboratory Project (http://collaboratory.nunet.net/) is a Northwestern University initiative funded by a $1.8 million grant from the Ameritech Foundation. The Collaboratory Project provides consulting, training, technical support, and information services to education, cultural, and nonprofit organizations interested in using network technologies to advance education. The Project's goal is to establish an easy-to-use, networked-based collaborative environment that enables organizations in the greater Chicago region to work together to share information, resources, and expertise.

The Collaboratory Project is part of the University's Information Technology organization and draws on the experience and technical expertise of the entire organization to support its mission. It works with individual teachers, school project teams, and multi-school collaborations in the Chicago Public Schools system and surrounding school districts. In addition, the Collaboratory Project works with museums, libraries, and cultural institutions to develop innovative, Web-based educational resources.

Network Initiatives

Network Initiatives are Web-based activities developed by the Collaboratory Project that teachers and students can join as part of established curricular activities. These initiatives enable students to share projects through dynamically-created Web pages, discuss their ideas using Web-based discussion and chat resources, provide gateways to Internet resources, and facilitate access to experts in the region.

Network Initiatives share a common database-driven architecture. Participants submit text, graphics, sound, and video files from a standard Web browser to a Network Initiative database on a Collaboratory Project server. Web pages are created dynamically from the database. New Network Initiatives can be created by the Collaboratory Project by modifying the underlying Web database application of an existing Network Initiative.

A teacher can join a Network Initiative from the Collaboratory Project Web site and use it to meet specific curricular needs. Students can participate with anything from a single computer and a modem to a fully networked computer lab or school. Once a teacher and students understand how to use a Network Initiative, which takes about an hour, they can participate and manage projects on their own.

Network Initiatives available on the Collaboratory Project Web site include:

- Cybraries: teachers and librarians create customized, curriculum-specific, searchable virtual libraries of Internet resources;
- The Internet Book Club: students share book reviews, poetry, writing projects, and other language arts activities;
- The Science Connection: a science resource that includes Northwestern University scientists and engineers who are available to help teachers answer science questions;
- MICNet: a resource for sharing and discussing student music compositions created on MIDI synthesizers; and
- MediaSpace—electronic postcards containing text, graphics, sound, and/or video are used for collaborative activities on topics as varied as community-based research, virtual travels, folklore and fairy tales, and writing about issues facing the U.S.

In addition to learning about the Network Initiatives, attendees will see examples of how Network Initiatives are being used by K–12 teachers in the metropolitan Chicago region in curriculum-based projects.

Conclusion

Network Initiatives leverage the ideas and experiences the Collaboratory Project has gained from working with teachers and schools on network-based projects that engage a larger community of students and teachers. Because Network Initiatives are participant-driven and are used in projects that are closely tied to the curriculum, they provide fertile environments for developing innovative collaborative projects and activities.

General Session: Curriculum and Instructional Strategies

Outstanding Developmental Software and Web Sites for Kindergarten through Sixth Grade

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Key Words: **software evaluation, developmental software, curricular integration, supports diversity**

As teachers scan the vast array of software in catalogs and brochures or surf the Internet, they cannot help wondering ... Should children in classrooms be using these products and if so, which ones? Teachers and administrators need help in evaluating software and Web sites to determine which products are developmentally appropriate and wise investments. They simply do not have the time, energy, or resources to review 400+ software products that are produced and marketed yearly and thousands of Web sites to select the 20% that are developmentally appropriate.

Yet, the kind of software children utilize in classrooms is a critical issue. Research has shown (Haugland, 1992) that when a classroom uses developmental software (evaluated with the Haugland Developmental Software Scale, 1997) accompanied with related off-computer activities, children have significant gains in intelligence, non-verbal skills, verbal skills, structural knowledge, long-term memory, complex manual dexterity, problem solving, abstraction, and conceptual skills. Furthermore, when a classroom uses non-developmental software, they have none of these gains and 50% losses in creativity. The research emphasizes that the type of technology classrooms utilize is critical to learning.

Topics include:

- An overview of the Haugland Developmental Software Scale, 1997 and how software is evaluated using the scale. The evaluation instrument is based upon 10 criteria and then an anti-bias deduction is calculated to ensure software reflects the diversity of society.

- A presentation of the software which was selected for the 1999 Developmental Software Awards, selected by Susan W. Haugland, Director of the KIDS Project (Kids Interacting with Developmental Software) at Southeast Missouri State University.
    - Publishers submitted software in two age groups (K-2 and 3-6). Eight categories were considered: creativity, language, math and science, multicultural, multipurpose, problem solving, thematic focus, and reference.
    - Software scores upon evaluation ranged from 1.0 to 9.0.
    - After the software was scored, software with a 7.0 or above was fieldtested with children. Based upon the children's feedback, scores were adjusted and the Developmental Software Awards selected.
    - Attendees will view screen captions of the software, listen to narrated descriptions of the software, and receive written descriptions, developmental ratings, operating systems available, costs, and publishers' contact information.
- An overview of the Haugland/Gerzog Developmental Web Site Scale (1998). The evaluation instrument is based upon 10 criteria and then an anti-bias deduction is calculated.
- The three types of children's Web sites will be reviewed. The outstanding Web sites, based upon the Haugland/Gerzog Developmental Web Site Scale (1998), will be demonstrated. Information regarding the URL, descriptions, and ratings for each site will be provided.
- A Web site will be presented, Young Children and Computers, where teachers can access evaluations of software, Web sites, and a variety of teacher resources. The Web site's URL is http://cstl.semo.edu/kidscomp/.

General Session: Exhibitor

Wide Area Networking (WAN) and Intranet/Internet Connectivity

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Key Words: **wide area network, Internet, intranet, fiber**

This session will discuss the various methods of implementing and using an effective WAN in K-12 education.

Summary

This session will discuss the various methods of implementing wide area networks, both over telephone links and single mode fiber. Methods of implementing intranet and Internet servers and data retrieval from the World Wide Web will be discussed. At the end of this session, attendees will understand the components required in making the connection from their school to their district, and beyond.

General Session: Exhibitor

Planning a Web-Based, Foreign Language Course

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Key Words: **curriculum, ESL, foreign language, Internet, student centered, cooperative learning**

Upper-level English as a second language (ESL) and foreign language classes have not made optimal use of materials available through the Internet. SAS Institute is currently working on a language course that would structure assets available on the Web for higher level language courses.

The unstated goal of all language courses is proficiency. Internet technology and language proficiency are both open-ended, with no single proscribed route to advance in each. In fact, the Internet is especially adaptable to proficiency because students can accomplish several things simultaneously.

The presentation includes a discussion of the course content selection process, as well as how technology can improve language instruction and interest, and thereby proficiency, at this level. Many of the technology examples are related to ESL and German, but the methodology and structure apply to other languages.

Some of the items to be discussed include:

- Text-based Web materials on language, and where and how to locate them
- Voice synthesis for listening to text-based files
- Audio and video files for direct "experience" in the language
- Computer sound recording and RealAudio
- Three major language elements: sound, structure, and meaning

- The implications of some reading studies on student interest and learning
- Distance communications in language study
- Technology-based cooperative learning and mixed levels in the language classroom

General Session: Distance Learning

Large-Scale Online Teacher Professional Development

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Key Words: **teacher education, netcourses, distance learning, Internet-based training**

As new software tools to support distance education emerge, and as bandwidth and access to the Internet increase in schools, more and more courses are being offered on the Internet and World Wide Web. Many teachers are choosing to take online courses for continuing education and professional development. Online courses differ in their format, ease of use, content, and pedagogical approach. As potential netcourse consumers, how do we know that netcourses will support best-practices teaching and learning and further the integration of technology into the curriculum? As netcourse producers, how can a netcourse be designed to ensure student learning, quality interaction, robust content authoring, and lifelong learning?

This session shares design principles and experiences from an ongoing effort at the Hudson Public Schools and the Concord Consortium. The Virtual High School Cooperative prepares teachers for Internet-based teaching through an online seminar called the Teacher's Learning Conference. Teachers from around the United States learn netcourse pedagogy and develop innovative courses for high school students on the Internet.

In this session, I raise the need for establishing netcourse standards and share a living document "Standards for Netcourses" in the context of designing online teaching professional development courses and netcourses for high school students. Standards in education have been useful for establishing a baseline of performance and quality of work; however, they are also the cause of much heated debate in reaching consensus to establish shared criteria among members of school communities. My goal in establishing standards is to ensure that quality online courses are being developed for students and teachers, as well as to encourage standards to be openly discussed and adopted more broadly by others developing online courses. Standards apply to the design of online inquiry, moderation, course content, pedagogical principles, online assessment, course navigation, and use of multimedia.

I illustrate standards with examples of best practices from the Teachers' Learning Conference, a graduate-level training course for teachers who wish to offer Virtual High School netcourses, and with examples of best practices drawn from Virtual High School netcourses. Netcourses being offered through the Virtual High School include courses in math and integrated sciences, humanities, foreign languages, and business.

The Virtual High School Cooperative, a Department of Education Collaborative Technology Challenge Grant, is delivering precollege courses on the World Wide Web to students across the United States (see http://vhs.concord.org/). Now starting its third year, the VHS cooperative has offered more than 40 courses to 500+ students located in urban, suburban, and rural schools. Teachers interested in joining the cooperative take this online graduate-level course to learn how to author instruction using the Lotus LearningSpace environment. Teachers also engage in asynchronous online discussions that focus on pedagogy, collaborative learning, and online moderation. Netcourses support asynchronous communication, online and offline activities, group discussions, collaborative work, electronic portfolios, and learning assessments. Given the multitude of ways to organize a curriculum and design activities for students, teachers can draw on netcourse standards to guide their design decisions as well as think about how to create standards in their own netcourses.

Research Paper: Curriculum and Instructional Strategies

Difficulties Bring Wisdom: Online Learners Learn How Online Communities Learn

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Key Words: **support, online collaborations, non-traditional education, transformational learning**

Abstract

This collaborative paper, created online by Ph.D. students in a three-year cohort learning program at the California Institute of Integral Studies, explores the development and felt experience of distance learning.

Introduction

Difficulties bring Wisdom
Struggles bring Knowledge
Endurance and Perseverance wrought Mastery
Life breeds Troubles
From Chaos I seek Peace
Lest I surmount obstacles aforementioned
Knell rings on this body
Peace shall endure

If body dance knell what a sad beginning
In my soul, I shall be FREEEEEE!!!

The poems and art in this paper are included as part of our discussion on the QUALITATIVE aspects of online learning. Our purpose is to both give a sense of the whole; the how are we doing/how does it feel to learn online, and to describe essences of this learning. A sample of what we learned is reflected in one of our own inquiry group member's posting:

> *"As I reflect on my view of how online communities learn, I am conscious of how new a concept this really is. How amazing that we can have relationships with people through thin little twisted wires, looking at computer screens and teaching and learning with each other. I'm in awe of what the human mind can accomplish, and yet inside I wonder why I thought it would be difficult."*

Methodology

We attempted an intentional interplay between reflection and making sense on the one hand, and experience and action on the other (Heron, 1996; Reason, 1994). We communicated with each other online and with our outside sources by e-mail, the dtl commons (online student commons at our Web site), and telephone. We followed case-study format (Denzin & Lincoln, 1994) in our open-ended interviews and critical thinking in our review of the literature. We posted our findings and then took turns integrating the text.

We pay explicit attention to the validity of this inquiry and its findings through triangulation with each of our own experience and other CIIS (California Institute of Integral Studies) online groups, the literature, and outside online learning communities.

As well as validity procedures, we bring a range of special skills suited to such experiential inquiry: poetry, art, self-knowledge, therapeutic and organizational skills, playfulness, and traditional roots.

Results of Our Inquiry: What We Learned

Online Learning: An Overview

The growth of distance learning has brought with it many complications and developments. In our research, we discovered that distance learning evolved from mail correspondence through radio and television to, now, the Internet—using a chain of computers linked together by telephone lines. As we set out to gather material for this research, the first question that came to mind was: What is distance learning? From an electronic point of view, Bruder (1989) defines it as:

> *"... the use of telecommunications equipment such as the telephone, television, fiber optics, cable broadcast, and satellites to send instructional programming to learners. The distance could be across the hall or across the continent, and the learners are students of all ages and levels, as well as teachers and administrators receiving professional development. Often, the learners have a chance for live interaction with the source of instruction and with other distant learners."*

We looked at the development of non-traditional education which hosts degree-granting online programs such as ours. In 1973, Edward B. Nyquist, then president of the University of the State of New York, spoke of the need for such alternative learning environments (Bear, 1992):

> *"Through native intelligence, hard work and sacrifice, many have gained in knowledge and understanding. And yet the social and economic advancement of these people has been thwarted in part by the emphasis that is put on the possession of credentials, those who cannot or have not availed themselves of this route but have acquired knowledge and skills.*
>
> *"There are thousands of people ... who contribute in important ways to the life of the communities in which they live, even though they do not have a college degree. Through native intelligence, hard work and sacrifice, many have gained in knowledge and understanding. And yet the social and economic advancement of these people has been thwarted in part by the emphasis that is put on the possession of*

> *credentials ... (they) will be denied the recognition and advancement to which they are entitled. Such inequity should not be tolerated."*

On this premise, non-traditional schools began mushrooming to cater to the needs of those with life experience.

Our inquiry moved to focus on the online community of learners in a non-traditional setting. In a telephone conversation, Dean Peter Pick of Columbia Pacific University (a totally non-traditional institution since 1978) attempted to answer the question: How do these non-traditional students learn?

> *"A great majority of millions of post-secondary students who are attending traditional college are doing so because it is a thing to do. Students in our program are doing so because it is a thing that means much to them. A majority of students are accomplished individuals. Our program affords them the opportunity to document their life experiences and earn credible diplomas for it."*

> *"Students in our programs begin by presenting evidence of their prior education and career activities. Then using guidelines provided by the university, they relate their interests to new independent study plans or a learning contract."*

In answer to our query: How do you know when a student has acquired a new body of knowledge? Peter answered:

> *"By demonstration of competency through one of several methods. Depending on the degree being pursued, a student also presents a bachelor's Independent Study Project (ISP), a master's thesis or doctoral dissertation to demonstrate that a certain standard of knowledge and ability has been achieved ...."*

It seems the most important aspect of the non-traditional method is the learning experience that each student brings into the program. This forms the core of each student's evaluation and the fulcrum about which further learning revolves. Primarily, non-traditional institutions award college level credits to students with commendable life experience by one or a combination of methods of evaluation: credit by examination, presentation of life experience portfolio, a presentation of sample works or awards, appearance for interview before a panel, written paper, presentation of copies of speeches given, or any other method that shows mastery of an aspect of life-learning (Brown, 1994). Students must be able to demonstrate that their life-learning experiences measure up to the standard of a required college course. It is important to note here that college level credit can be earned for most activities that are taken for granted, such as reading the Bible or visiting a museum. All of these are learning processes that non-traditional institutions consider to be superior methods of learning, often overlooked by traditional colleges.

Notable Learning Difference between Non-Traditional Schools and Online Non-Traditional Schools

Collaboration as a learning tool is a common thread linking the learning methodologies of both non-traditional face-to-face (FTF) and online schooling. The non-traditional school employs documentation as the major concern of the learning process, whereby students interact with their own life-long learning. Learning is documented by bringing such knowledge into agreement with the newly acquired field or area of interest under the collaborative supervision of a mentor. In contrast, online students learn more from collaboration with other members of their cohort, as evident by our own learning at CIIS. The success of all non-traditional methods is based on the upheaval of past knowledge of the individual student, and the development of a totally new expertise from a marriage of past knowledge with the present or newly acquired information. This is transformational learning.

The learning that occurs with peers has been documented as a resounding element in learning in general (Plater, 1995) and we believe the online environment creates a special "field" for transformational learning. We found this field created a unique online experience of support.

Support

We were curious about what influence "support" had on how online communities learned. While we were engaging in our research questions, Cohort 7 was preparing for their Demonstration of Competency (DOC). Cohort 7 had chosen support—of each other and the group as a whole—as a primary focus.

To determine how Cohort 7 defined support, the following references to support were identified by reviewing Marti Anderson's and Robert L. Stilger's, *Introduction: Support Paper* (1998): "web of connection and support that sustains us emotionally, spiritually, and intellectually," "support process of action/reflection cycles," "to be collaboratively creative," "to step outside of our own perspective," "to be of service to ourselves and others," "a dance," "action," "attention," "light-hearted community," "dialogue," "love and honesty," "deeply listened to and heard," and "mingled energy." Support was also defined by what it was not ("shadow side"): "lack of movement," "breakdowns in process," "breakdowns in dynamics," "getting side-tracked," "non-response to thoughts and ideas," "feeling judged or ignored," and "silence."

Cohort 9 says:

> *"I think/feel online communities learn from their interactions with each other, enhanced by the trust and relationships built up at the intensives. As we open our hearts and minds to each other with interest, we start to really listen and to hear what we need for our own growth and development."*

This point—that face-to-face contact is also needed for learning—is supported by other sources. Online learners feel the "absence of body language and other visual cues (which call for) extreme effort to generate dialogue and not just have a subject fade away before people respond" (Weisner,1998).

A member of Cohort 3 writes in response to: How do online communities learn?:

> *"Online communities seem to" me to learn by first developing a community where it is safe to take risks and explore who we are as a collective. This takes a constantly present facilitator as well as skills in online communications, as well as leaders who take first steps to reveal themselves. Then, students in online learning communities begin to learn together, both cooperatively and collaboratively."*

Another C3 member, who has also experienced every online cohort at CIIS, writes:

> *"Based on my experience with C3, online communities learn through developing a continuous connection of love and trust, of acceptance of differences, and of creating an online container that holds all of this continuously. This is the key ... the online environment allows for this trusting connection continuously, where face-to-face really doesn't ... It detracts from my learning experience only if I insist that is the only way I can access learning, and forget that it is merely a window to the world, and that I can do all of these things in my face-to-face life. The online medium, is just a tool ... it's how we use it that makes it a tool for supporting a learning community ... I have found that the online component can be used to support learning in the world and in our communities."*

The ability of the environment to hold/support all the members' experiences is an on-going theme defining what is necessary for a learning community . Feeling not supported is the shadow side of online learning and is also experienced by members. From Cohort 7: "I try not to get in my feeling about the cohort when I am in these dark moods. The reason is simply, that the cohort is my source of support," "I expect to EXPERIENCE personal growth through support ...." "I get support when we can fight like cats and dogs and underneath it all we know we care very much for each other," "Sometimes we felt a lack of movement and this does not feel supportive," "Many of us have felt at one point or another a lack of intellectual support and challenge," "For some of us, the cohort is not a place we experience spiritual support."

From the dtl commons:

> *"... soon I start to lose interest if the pace isn't matching mine. But I have responsibilities to my cohort to keep things going, so I constantly feel I have to weigh the group effort vs. my individual learning effort. This is a different kind of learning, and, I've got to admit, emotionally stifling."*

From our own cohort C11:

> *"At this point I'd like to say that I am feeling it very difficult to keep up with onlineness. I am feeling the loneliness of it. Just a comment from my home office where I am surrounded by machines."*

The Medium of Electronic Learning

One C11 member states:

> *"The one thing that I have noticed about everyone here ... there seems at times to be a plea for help ... and then appears a metaphor, a story, a summary ... a copy of an article or book, a heartfelt explanation ... or you borrow learning from each other, like some did in the research design for the research course last quarter ... I am noticing that there is a strong sense of compassion and responsibility for each other. Our "field" is strong ..."*

Through the Internet a Web of connection has been established for those who participate. The Internet tool has been described as "paving the way for exploration, like artists' tools are ready for contemporary expression at the vanguard of society" (Will, 1997). The nature of the electronic medium for online learning communities is developing a way of being and learning that is different than in a face-to-face classroom.

One online learner responds to our inquiry: How do online communities learn?

> *"Members provide crucial support to each other in a 24-hour a day format. This support can be provided both publicly (in the forums) and privately (e-mail and chats)—The community creates a dialogue that engages all the learners, and mutually challenges their thinking. The online forums allow for reflection, contemplation, and great depth of discussion. Connectivity: provides means for information and idea transfer independent of time and place; logistically the community can learn (and remain a community) despite the demands of daily life ... the written record of the classes provides archives for research, the ability to look back at our collective learning process, and learn from that."*

"The information stays with you" is the thesis of the online educational method at the University of Phoenix. Comparing this method with a regular classroom, Joe Brieding, a self-employed University of Phoenix MBA graduate (1998) said:

> *"in a physical classroom, you ask questions, and the answer comes back, and you move on to the next question, and the answer kind of goes away. In the online situation, you get to think about it. The 'wait time' you get on a question is really, really valuable... discussions tend to dig deeper into each subject, giving you a better understanding of how you can apply ..."*

Learning seems to go deeper, say many, and they are different after it. The learning is internalized and made their own: transformation occurs.

> *"As one revisits a conversation, recalls a situation, sees how others handle it (silently or otherwise), the learning goes on, deeper, broader."*

> *"To me, learning online has allowed time to think about a response, encouragement to make that response at any later date, and a great deal more insight in topics than traditional lecture where often only the instructor holds the floor."*

> *"Cohort 3's experience taught us the significance of being ruled not by explicit rules but by good intention and consciousness ... I see a similar pattern taking shape with cohort 7. I wonder if the medium is influencing the shape of the cohort's journey ... Of all the spoken and unspoken norms, the only one remaining a consistent norm, seems to be that we should care about each other, a level of concern, involvement, empathy or sympathy should prevail ... This does not, it seems, set a level of participation or doing. Rather, it sets a level of trust. The online cohorts have to perhaps think seriously and creatively as to how they can get the unconscious, movement, spiritual, intuitive dimensions encompassed in their community building process."*

A reflective field is created with online learning where reciprocity and spirituality are "essential elements" (Weisner, 1998). Weisner speaks of Rheingold's (1993) research into virtual communities where there is reciprocity which is "like a gift economy where people do things for one another with the spirit of building something between them." When that spirit exists, he suggests, everybody gets a little extra something, a little sparkle from their more practical transactions, and different things become possible when this mindset pervades. Spirit, although difficult to define, and even harder to foster online, is considered to be one of the most important aspects for collaboration and learning.

This electronic field creates a playspace, a container that perhaps even resonates with our own electronic flesh and blood bodies: minus our faces and our skins. In this online space Turkle (1995, p.70) speaks of how we learn as in a video game, where "...you soon realize that to learn to play you have to play to learn. You do not first read a rulebook or get your terms straight." We are interactive with the medium itself, and must be so, in order to learn. Is this the definition of spirituality? Are we connecting in this way in the same way we connect to the Universe?

Other online learners report similar thinking:

> *"We were astonished at how quickly we formed close bonds, attributable perhaps to the 'safety' of the online medium which tends to be less threatening than face-to-face encounters ... We were able to absorb the richness of peoples' life stories, feelings, and thoughts, without the distractions created by a physical presence. This purity of interchange, spartan as it was, is often put forward as a major drawback of online communications. For us, it was to prove otherwise." (Forming the Circle: Growing a Learning Community).*

> *"This flexible organic movement really bespoke the notion of a container that we created which responded to our group needs as they emerged. This 'container' held our willingness to look and look again at ourselves, each other and our relationships as a part of our learning."*

> *"The online learning environment can be said to resemble a concentric spiral with the individual at the center and the 'circles' of small group, cohort, Institute, collective MetaNet (our Web site host) learning community and the Internet beyond as an open-system learning medium. Learning and change comes from within each individual and affects the concentric spheres in a systemic relationship resembling ripples radiating outwards from a stone cast in a pool of water."*

And the shadow side of the environment also exists. One CIIS student writes about the detractions that

> *"included the dryness and narrowness of text-based communication, a sense of isolation and tiredness from sitting alone in front of a computer screen at home, day after day. I felt at times that my speaking skills were getting rusty relative to my writing skills and that the visual/text input was a bit lopsided. Technical difficulties could arise, and sometimes dialing in was a struggle ... Another distraction was the misunderstanding, suspicion of; and lack of credibility regarding online learning amongst the general public and within CIIS itself during the 1993–1996 time period when I was participating in the program."*

The online learning environment for some is "neutral" and many find it not conducive to learning, especially when their skills are not at their fingertips. We experienced this in C11, notably at the very beginning, where some members were completely unfamiliar with the Internet, or had purchased new equipment and had a huge learning curve to overcome just dealing with getting to the virtual classroom. This was also experienced in C9. Our cohort dealt with the differences in computer skills by identifying those who were skilled, and using their expertise to teach the rest. This has helped to build a stronger group, and has engaged us more fully in a group learning environment, where all are learners. Says C11:

> *"For me, being primarily online isn't limiting, in a negative sense. More in a hunger for more sense ... And, I'm finding, the more awareness and consciousness I have, as I participate here, the more I'm fed wonderfully full circle!"*

> *"This environment wouldn't work nearly as well for me without the group. I can't imagine doing this on my own. Having 15 people literally at my fingertips makes so much difference: support, assistance, friendship, etc."*

The Medium as a Theme within Our Inquiry Group

In our own research process, we felt that we were "held" by each other on and offline and that our presences were known and experienced even though we were not literally in touch. The communities we have built and are in the process of building online appear to be essential to our learning. We depend on each other for support and encouragement, guidance and understanding. It seems to us, as it seems to other learners, that the learning wouldn't be the same without the group; that the interaction in many cases is vital for the learning.

We liked the asynchronic nature of the online medium:

> *"Much of (my learning) is linked to the medium, to this online environment that captures the written word and displays it for all to see, and review, and look at again. The ability to be in the classroom at any time, on any day, and not miss a thing. The ability to go back and re-read a discussion, adding points here and there, gaining new understanding from the review. This is a new kind of experience, and a new way of learning."*

We too missed the face-to-face contact and sometimes yearned for more. We felt loneliness when we weren't in touch and not as able to learn.

> *"... Hi everybody—whew I feel better now we're all here. I have all of your faces and bodies in my head (I hope it's not too crowded in there) and know I was having all kinds of feelings about not having us all here in our space together. I like all your blue names on my screen with those blue lines under them. I feel your hugs and your eyes. I am learning by being held, and that it matters that I learn.*

Summary

This learning experience has been a marvel of adjustments and excitement, frustration and joy for us. It has stretched us beyond our imaginations into a new world of interconnection We have learned so much, and yet there is so much yet to know. We continue to feel we learn by digging into our own backyards and bringing our treasures to share with each other, seeing what we've all found.

Reflections, a mirror, a pond, light
Trust—5 sets of hands working together, but not always in sync
Emergence, to trust the process; to trust the hands
Learning that one knows
Being together, linked in mind and through technology

Exploring separately and together

Reflections, a mirror, a pond, each other.

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General Session: Curriculum and Instructional Strategies

Managing the Design, Development, and Evaluation of Multimedia Projects

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Key Words: multimedia, assessment, management, DDD-E, evaluation

Developing multimedia projects offers students the opportunity to work collaboratively, to engage in multimodalities of learning, and to use a constructivist approach to learning. It engages students in a real-world learning environment where they must conduct research, organize their thoughts, make decisions, work as a team, and present their ideas in an interesting and understandable format. There are multiple, easy-to-use tools on the market that can provide students with these opportunities; however, ease-of-use does not guarantee successful learning outcomes or projects.

Conveying ideas and instruction through a computer involves a wide variety of considerations, including how to best present the information, which media elements to use, and how to assess the effectiveness of the program. Careful planning is critical in the development of multimedia projects. Planning saves time, reduces frustration, eliminates fragmented learning experiences, and results in a better project. Following a systematic plan and development model is recommended.

To help teachers manage the design, development, and evaluation of student multimedia projects, this session focuses on the systematic design of multimedia projects. It introduces a model called DDD-E (Decide, Design, Develop, and Evaluate). The authors will address each stage of the DDD-E process and discuss the benefits and limitations associated with assigning multimedia projects, including grouping strategies, computer schedules, resources, classroom management issues, and assessment techniques.

General Session: Technology Implementation

A Community Safe Haven

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Key Words: Internet, community, resources, adults, grants, Pioneering Partners, policemen

Crown Point High School students have a greater awareness of the positive impact that technology makes possible. The school opened its doors and technology resources to students and adults after-hours. This effort was an attempt made to reduce inappropriate after-school behaviors and increase students' educational achievement. As a result, Crown Point citizens have a technology community resource center. This program registers successes of assisting the students develop greater skills and self-esteem, and a community of lifelong learners.

The Indiana Criminal Justice Institute Board of Trustees awarded Crown Point Community School Corporation (CPCSC) a $35,000 Safe Haven grant. Governor Frank O'Bannon instituted the Safe Haven Education Program to provide funding to Indiana school corporations and communities to jointly develop plans to open local school buildings for extended hours to its students. The plan is designed to accomplish the following goals: (1) reduce substance abuse, (2) reduce violent behavior, and (3) promote educational progress. Since Crown Point students and community members have continued to request access to Internet and computers during after-school hours, the Safe Haven grant funds have been successfully implemented to meet community needs and the Safe Haven grant goals.

Crown Point's project is a collaborative effort among CPCSC, the Crown Point Police Department, businesses, community members, and parents. The vision is to provide opportunities to link the faculty, students, and the Crown Point community to the various components of the global community. This grant has enhanced the mission of the CPCSC, which fosters a partnership of students, families, staff, and community to ensure that all students become lifelong learners through the highest quality educational program. The goals of the grant proposal are to provide training, equipment, and support so that all participants can utilize computers and Internet to enhance learning. To accomplish these goals, the participants have access to the high school media center's lab and business department's lab, both of which include a T1 connection to Internet. Grant funds are used to hire teachers, high school students, and policemen to provide participants access to computer labs after school hours, under the guidance of trained instructors

Although the original grant was directed toward the Safe Haven project goals, the program blossomed and became a community resource center. Results of coalition building include: (1) development of an informational World Wide Web site by Crown Point police; (2) collaboration of parents and students on multimedia projects; (3) usage of labs by students to complete class projects; (4) Internet searches by senior citizens of retirement, health, and investment sites; (5) communication among family members using e-mail; (6) introduction and improvement of keyboarding and software application skills; and (7) production of instructional videotapes by high school students.

All participants continue to have the opportunity to share ideas, ask questions, and establish a wider community network. They are able to access state-of-the-art computers and peripherals, use the Internet to access online resources and exchange e-mail, use software effectively, improve keyboarding skills, and design personal Web pages.

General Session: Exhibitor

Building Information Literacy with Electric Library and Mini-Research Strategies

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Key Words: **mini-research, critical thinking, library of queries, research strategies, state learning standards, information literacy standards, Electric Library**

Research is quickly emerging as the 4th R in education in the Information Age. This new emphasis on research is not just more "term papers" but requires that all students become critical readers and thinkers, sharing their ideas using a variety of media formats. Mini-research activities provide a way for students at all levels and in all subjects to learn these new skills. The focus of mini-research is to teach the problem-solving process in small steps, integrating past and current information. This ongoing searching, critical reading, analyzing, synthesizing, and reporting, keeps student knowledge current and reinforces essential critical thinking skills. The research process is not an add-on exercise to get ready for college, but a vital and totally integrated learning experience that students will use personally and academically for the rest of their lives.

Award-winning Electric Library provides a full-text educational database that combines the power, ease-of-use, and authoritative content that helps students get the information they need. Electric Library's curriculum resources provide librarians and teachers with the necessary educational tools to help implement a research-based curriculum. National Information Literacy Standards (AASL), National Educational Technology Standards (ISTE), and state learning standards provide a powerful impetus to create an Information Age curriculum. Technology and the Internet provide the vehicles to make this vision possible.

Topics discussed (includes four handouts):

- Mini-research defined, with examples
- Mini-research strategies for all teachers
- Integrating mini-research activities with Information Literacy Standards
- Integrating mini-research activities with state learning standards
- Using a Query Library to simplify and speed-up research
- Demonstrating the power and ease-of-use of Electric Library

Presenter

Carl Janetka retired after 38 years of teaching and years as Technology Supervisor in the Upper Dublin School District (PA). He is presently the Curriculum Specialist at Infonautics Corporation (Electric Library) in Wayne, Pennsylvania, and author of the *Teacher's Guide to the Mini-Research Process* and numerous Query Libraries that correlate with state learning standards.

General Session: Exhibitor

Using Writing with Symbols 2000 for Literacy

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Key Words: **literacy, picture processing, symbol writing, Picture Communication Symbols, inclusion**

This session will be an introduction to Writing With Symbols 2000, a word/graphic processor that allows you to make Rebus stories simply by typing. The program runs on Windows 95 and contains 3,800+ Picture Communication Symbols (PCS) and 4,000+ Rebus symbols. Use it to write symbol stories or to adapt materials to include the special needs student in the regular classroom. A teacher can also set up writing environments that allow a student to write by selecting pictures.

Writing With Symbols 2000 is a creating tool for parents, teachers, and students. Use it to teach literacy by creating the following:

- Picture stories for emerging readers
- Picture strips to use with reading books and everyday class curriculum to help with the inclusion of a special student
- Picture directions for guidance
- Picture recipes for independence
- Picture schedules for children with autism

Just by typing, it will allow you to bring your student's day into print, to share with friends and family.

Writing With Symbols 2000 also produces speech output if you have a sound card in your computer. Create your story and have it read aloud. A perfect companion during circletime tales, giving an oral presentation, or just reading a story aloud.

The software program contains 3,800+ Picture Communication Symbols (PCS) and 4,000+ Rebus symbols. Also included is a spelling checker suggesting both text and pictures.

Writing With Symbols 2000 will allow text users to add symbols to their documents, will help teach symbol users to associate symbols with text, and allow non-speaking individuals to read their stories aloud.

Stimulating K–12 Technology Integration: Curriculum Design Considerations

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Key Words: **curriculum design, staff development, teacher beliefs, technology integration**

The current literature on technology and teacher education indicates that teacher education, particularly preservice, is not preparing educators to work in technology rich classrooms. Further, the literature indicates that when developing technology-related courses the primary focus is on the hardware and software. While a necessary aspect, a tool-based approach can not be the sole focus of the curriculum if we wish to increase technology integration in K–12 instruction.

This hands-on presentation describes a course design process based on the assumption that technology integration is accelerated by addressing the "cultural" notions of teaching and learning held by all teachers. This assumption is supported by the work of the Apple Classroom of Tomorrow (ACOT) Project. Dywer (1997) states that ACOT teachers found effective and strategic ways to use technology in their classrooms. However, the speed and direction of this evolution was closely tied to changes in teachers' beliefs about learning, about teacher-student roles, and about instructional practice—ideas not always addressed in technology related course work.

This presentation describes a curriculum design process giving equal weight to four elements, only one of which is developing technology skills. The four elements are: (1) making explicit teachers' beliefs about learning, about teacher-student roles, and about instructional practices, (2) having teachers identify the elements of their instructional tool box using a framework developed by David Perkins of Harvard University, (3) providing time for course participants to reflect on what in the current practice works well and what areas need improvement, and (4) embedding technical skills required to use technology tools (databases, spreadsheets, multimedia, telecommunications) in the context of constructivist teaching practices. Providing time to address these additional factors does significantly reduce the amount of class time participants have to learn specific hardware/software related skills. However, participants complete their course work with definite ideas and plans for how they can use technology in their classrooms.

This outcome addresses a major conclusion of the ACOT project. Dwyer (1997) acknowledges the importance of technical training by stating that technical training is a key ingredient to reducing teacher stress and bolstering their confidence. However, Dywer also indicates that based on ACOT experience, it remains an isolated exercise soon forgotten, unless teachers who are learning technological basics are also immersed in an environment that builds links between technology, instruction, and learning. The curriculum design process described in this presentation is one way to create the links described by Dwyer.

General Session: Curriculum and Instructional Strategies

Reaching Out: Finding Videoconferencing Partners for Learning

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Key Words: distance learning, collaboration, content resources, partnerships

The most frequently asked question regarding videoconferencing in education settings is, "Who can I talk to?" The second most frequently asked question is, "What can I do with them?" This panel of practicing videoconferencing experts will answer these questions with clarity and examples that will leave every participant excited about the possibilities of educational applications with high-quality videoconferencing.

Each panel member will have the opportunity to make some opening remarks regarding issues that make a successful videoconferencing relationship, including: philosophy, planning, experimentation, creativity, curriculum, and strategies. Some moderated questions will lead the discussion toward resources for linking videoconferencing educators together (listservs, Web sites, content providers, etc.) and strategies for making and establishing effective relationships with other sites.

Additional questions will broach the subject of videoconferencing content providers, such as museums and zoos, and how to contact them, develop relationships, initiate new ones, and, most importantly, integrate their content into student and classroom activities. The panel will conclude with vivid descriptions of how these strategies have been put into practice in their own environments, with great success. The panel will field questions from the audience and will encourage audience participation through an open and honest discussion of the issues. Attendees will be able to suggest additional strategies, content providers, and applications to the group.

Participants will leave the panel with several concrete ideas. One is an understanding of WHY partnerships are so critical to videoconferencing in education. These concepts will be born out of a discussion of some philosophies of distance learning that are, perhaps, new to many participants. Attendees will further leave the session with many resources for actually making contact with others and creating partnerships. These include educational videoconferencing listservs and Web sites, videoconferencing lesson plan guides, and at least a few names and phone numbers of other educators that have videoconferencing and are looking for partners.

Research Paper: Current and Emerging Technologies

A Computer Game to Teach Programming

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Key Words: **learning computer programming, interactive tutorials, animated programming**

Abstract

ToonTalk™ is an animated interactive world inside of which one can construct a very large range of computer programs. These programs are not constructed by typing text or arranging icons, but by taking actions in this world. Robots can be trained, birds can be given messages to deliver, and so on. ToonTalk has been described at NECC '95 (Kahn, 1995) as well as (Kahn, 1996a & 1996b).

This paper describes the design and preliminary testing of an interactive puzzle game that functions as a ToonTalk tutorial. Children are presented with a series of interactive puzzles in a game-like narrative context. The puzzles gradually introduce programming constructs and techniques. Each puzzle presents the player with a very limited selection of ToonTalk objects. Even some very young children are able to solve the puzzles because the search space is so strongly constrained. And yet players do not behave as if the puzzles are too easy—the children are clearly challenged. The sequence of puzzles is carefully designed to gradually introduce new concepts, one at a time. Testing has shown that both children and adults enjoy the puzzles and have learned some sophisticated programming skills.

Introduction to ToonTalk™

ToonTalk is a programming "language" whose source code is animated (Kahn, 1995). (ToonTalk is so named because one is "talking" in (car)toons.) This does not mean that it is a visual programming language where some static icons have been replaced by animated icons. It means that animation is the means of communicating the entire meaning of a program to both humans and computers. One programs in ToonTalk by directly manipulating objects in a virtual animated world. If, for example, one needs to swap the values of two locations, what can be more natural and easy than grasping the contents of one, setting it down, grasping the contents of the other, placing it at the first location, and then moving the original item to the second location? (See Figures 2-6.) This is something a very young child can understand and do, while only a programmer can write the equivalent code. (See Figure 1.)

```
temp = x;
x = y;
y = temp;
```

Figure 1. Swapping two items in C

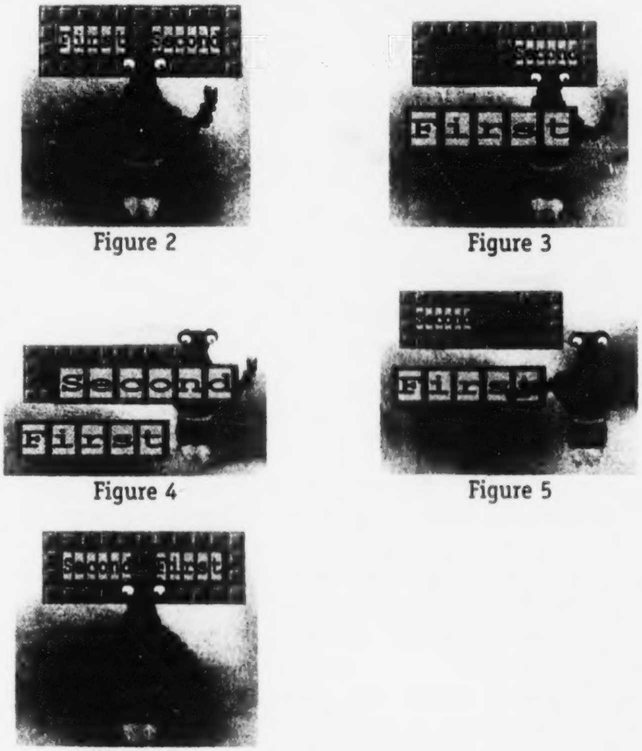

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

Figures 2–6. Snapshots of the creation of a ToonTalk program to swap two items

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Computer scientists strive to find good abstractions for computation. In ToonTalk a critical goal is to find good "concretizations" of those abstractions. The challenges are twofold: to provide high-level powerful constructs for expressing all programs and to provide concrete, intuitive, easy-to-learn, systematic game analogs to every construct provided.

The ToonTalk world resembles a twentieth-century city. There are helicopters, trucks, houses, streets, bike pumps, toolboxes, hand-held vacuums, birds, boxes, and robots. An entire ToonTalk computation happens in a city. Most of the action in ToonTalk takes place in houses. Homing pigeon-like birds provide communication between houses. Birds accept things, fly to their nest, leave them there, and fly back. Typically houses contain robots that have been trained to accomplish some small task. A robot is trained by entering into his "thought bubble" and showing him what to do. The robot remembers the actions in a manner that can easily be abstracted to apply in other contexts.

The behavior of a robot is exactly what he was trained to do by the programmer. This training corresponds in traditional terms to defining the body of a method or clause.

- sending a message by giving a box or pad to a bird,
- spawning a new process by dropping a box and a team of robots into a truck (which drives off to build a new house),
- performing simple primitive operations such as addition or multiplication by building a stack of numbers (which are combined by a small mouse with a big hammer),
- copying an item by using a magician's wand,
- terminating an agent by setting off a bomb,
- changing a tuple by taking items out of compartments of a box and dropping in new ones.

Figure 7. Possible actions of ToonTalk robots

When the user controls the robot to perform these actions, she is acting upon concrete values. This has much in common with keyboard macro programming and programming by example (Smith, 1975). The hard problem for programming by example systems is how to abstract the example to introduce variables for generality. ToonTalk does no induction or learning. Instead, the user explicitly abstracts a program fragment by removing detail from the thought bubble. The preconditions are thus relaxed. The actions in the body are general since they have been recorded with respect to which compartment of the box was acted upon, not what items happened to occupy the box.

The ToonTalk Puzzle Game

A carefully designed sequence of puzzles can be pedagogically very effective. A series of puzzles is more appealing to most children when it is embedded within a narrative adventure. The ToonTalk puzzle game starts with a brief "back story." An island is sinking and a friendly Martian named Marty happens to be flying by and rescues everyone. He is nearly done when he crashes and is hurt. The player has volunteered to rescue Marty. Marty, because he is hurt (you can see his arm in a sling and his bruises), can't get out and build the things needed to fix his ship. So he asks the player to make things for him. The player goes nearby where the components he or she needs can be found and has to figure out how to combine them. When stuck or confused the player can come back to Marty who provides hints or advice about how to proceed. If a player is really stuck on a particular problem then Marty gives the player detailed instructions so he or she can proceed to the next puzzle. Note that getting advice or hints from Marty fits the narrative structure since Marty knows what to do but is too badly injured to do it himself.

In order to fix Marty's ship, the first job is to fix the ship's computer. The computer needs numbers and letters to work. The goal of the first level is to generate the numbers needed. The culmination of the level is the construction of a program that computes powers of two (1, 2, 4, 8 and so on to 2 to the thirtieth power). The next level involves the construction of a program that computes the alphabet. The next task is to fix the ship's clock. Solving these puzzles involves measuring time, mathematics, and some new programming techniques. At one point, the player has constructed a number that shows how old he or she is in seconds. And the number changes every second!

A Detailed Look at Some Programming Puzzles

It is instructive to look at some puzzles in detail. The first real program a player builds is in the ninth puzzle. Marty needs a number bigger than 1,000,000,000 for the computer. When the player goes into the room all she finds is a box with the number 1 in it, and a robot with a magic wand capable of copying things. The player needs to train the robot to repeatedly double a number. Several of the earlier puzzles prepare the player for this task. The first three puzzles introduce numbers, addition, and boxes (data structures). In the fourth puzzle, Marty needs a number greater than 1,000 (see Figure 8). When the player goes next door, on the floor is just the number 1 and the magic wand (see Figure 9). There are only two choices: do something with the number or do something with the wand. It turns out that in this context there is nothing that can be done with the number. Marty has already informed the player that pressing the space bar will turn on the wand. Even children as young as six years figure out how to pick up the wand, move its tip over the number, hit the space bar, and then drop the copy. If they drop the copy on the number on the floor then the two 1s will be added (in an entertaining way, by a little mouse with a big hammer). The trick to this puzzle is to repeatedly copy the number and add it to itself, thereby doubling it each time (see Figure 10). In addition, the magic wand has a counter that is initially set to 10. After 10 copies, it has run out of magic and won't work anymore. This helps constrain the search for a solution. (This is not an easy puzzle for most 9 or 10 years olds. Many, for example, initially make the mistake of making many copies and then adding them.) The solution requires the player to repeat the same action 10 times. Avoiding such tedium is a motivation for programming robots to do the work for you.

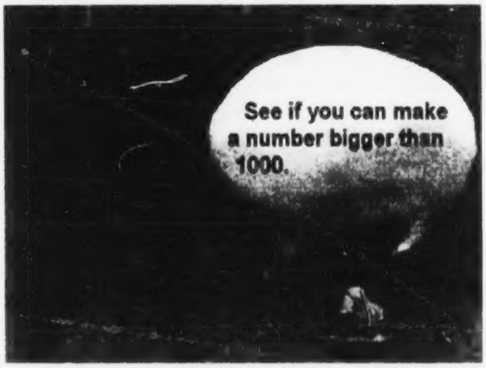

Figure 8. The injured alien introducing the fourth puzzle

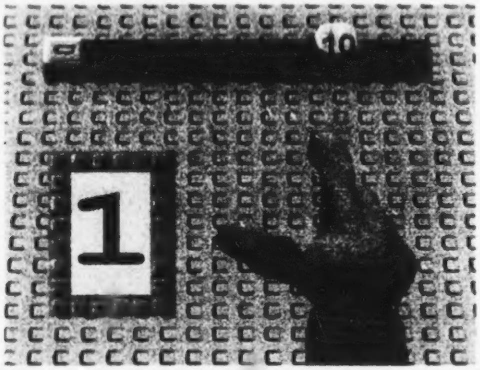

Figure 9. The initial state of the fourth puzzle

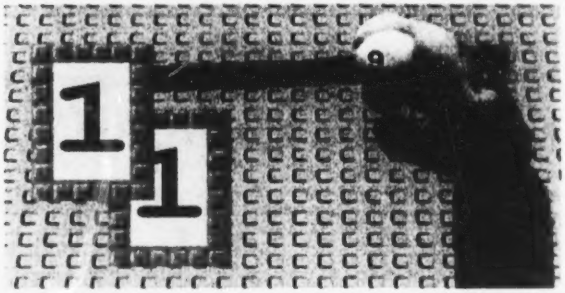

Figure 10. Using the Magic Wand to copy a number during the fourth puzzle

Just before the ninth puzzle, the player is introduced to robots and builds her first program. This puzzle is very simple. Marty needs a box with two zeros in it. When the player goes next door, she sees a robot with a magic wand and a box with one zero in it (see Figure 11). The wand is stuck to the robot and can't be used to copy the box. Most players discover that you can give the box to the robot (and those that don't, do so soon after getting hints from Marty). When they do, they see an animation of the thought bubble of the robot expanding and the player is now controlling the robot and the box with one zero in the robot's thought bubble. Nothing else is there, so most players try to train the robot to copy the box. The

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robot started off with a very small memory—only enough to remember two steps. When the player trains the robot to copy the box and then join the copy with the original box, the robot's memory is full so his thought bubble shrinks back down and the player is back on the floor with the robot and the box. The robot now knows what to do when given a box, so it repeats what it was trained to do and copies the box.

These early puzzles are designed to simplify some programming tasks. For example, the player doesn't need to know how to terminate the training of a robot. When the limit on the number of steps the robot remembers is exceeded, his training is automatically terminated. Similarly, the counter on the magic wand ensures that the robot will stop after the correct number of iterations. In later puzzles, these tasks become the player's responsibility.

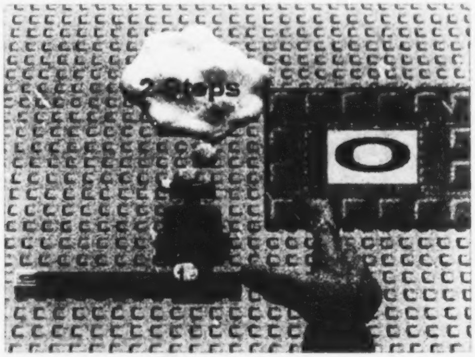

Figure 11. The initial state of the eighth puzzle

By the time the player starts the ninth puzzle, he or she has performed the prerequisite actions and must combine them properly to train a robot to repeatedly double a number. The player is presented with a robot holding a wand good for 30 copies and a box with a 1 in it. Again the robot is limited to remembering only two step programs. Because there is only the robot and the box to work with, and because of the limitations imposed on the robot, this otherwise overly ambitious early programming example can be solved by most players with few or no hints. And yet, the constraints do not make the puzzle trivial—experimentation, thinking, and problem solving are necessary to solve the puzzle.

The Pedagogical Importance of the Puzzle Game

There are many ways in which children can learn to program (Kahn, 1998). Typically, the most effective is by many one-on-one sessions with a very knowledgeable and skilled teacher. Unfortunately, such teachers are in short supply. On the other hand, some children learn well by a self-directed exploration of ToonTalk in free-form mode. However, they seem to be the minority. Most children ask what they should do next rather than explore on their own. For them the puzzle game is ideal. They find it fun and challenging but don't feel lost. A good series of puzzles actually leads a player step by step where the puzzle designer wants to go. The players don't feel as if they are being led anywhere but have the illusion that they are in control. The

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puzzles so constrain the set of objects that can be used and how they can be used that the player has only a few choices.

Even among those children for whom the puzzle game is well suited, there is variation from those that want to figure out everything themselves to those who very quickly want hints. The ToonTalk puzzle game deals with this by keeping Marty in another place. If you come to him empty handed or with the wrong thing, he will give you a hint. Each time you return during the same puzzle you get a more revealing hint until eventually you get detailed instructions from Marty. This behavior accommodates a wide range of learning styles.

In addition to free form exploration and the puzzle game, ToonTalk also includes demos. Here the child can observe a playback, with synchronized narration, of the demonstration of some programming construct or technique. This passive viewing has its place for many children but the learning is typically superficial unless followed by puzzle solving or free form construction.

An automated intelligent tutor (Selker, 1994) is another approach to teaching programming. As the user performs actions, the tutor maintains a user model and attempts to tutor the user. In ToonTalk's free-form mode, Marty can play the role of a tutor. He maintains a database of which actions the user has performed and suggests new ones. The suggestions are based upon what the user is currently doing and what he or she has already done. This kind of tutoring has worked well with a minority of the testers. It is a good complement to the other learning modes. A much more sophisticated automated tutor would presumably be much more effective but much more difficult to implement.

Testing

The puzzle game of ToonTalk has been tested with two classes of 24 children in a fourth grade class in Menlo Park, California. Each pair of children was observed using ToonTalk for three, 40-minute sessions. No formal testing was performed but nearly all the pairs of children solved the first 25 puzzles without assistance. The children had no prior exposure to ToonTalk and only two had any prior exposure to computer programming.

The ToonTalk puzzle sequence has a "self-testing" character. Puzzle Number 15, for example, is a difficult programming task for novices—generating a data structure containing 1, 2, 4, 8, and so on up to 1,073,741,824. The prerequisite knowledge for constructing such a program was acquired in solving Puzzle 9 (constructing a program to compute 2 to the 30th power) and Puzzle 13 (constructing a data structure filled with zeros). These puzzles, in turn, rely upon having learned in earlier puzzles how to double a number and how to train robots (construct programs). The fact that the children succeeded in solving the puzzles indicates that the puzzles have succeeded and the children are learning computer programming.

There is also a beta version available on the Internet (see http://www.toontalk.com) and testers around the world have worked with the puzzles. The resulting anecdotal evidence is that a wide range of people can work through the puzzle sequences. For example, a 6-year-old boy in Colorado solved the first 25 puzzles. He was not able to read, however, and required an adult to read the text. ToonTalk has since been augmented with a text-to-speech capability so even that kind of help is no longer necessary. Another example is a 25-year-old woman with no programming experience who solved all 62 puzzles on her own.

Related Work

Rocky's Boots and Robot Odyssey were two games from The Learning Company in the early 1980s that excited many computer scientists. In these games, one can build arbitrary logic circuits and use them to program robots. This is all done in the context of a video game. The user persona in the game can explore a city with robot helpers. Frequently, in order to proceed, the user must build a logic circuit for the robots to solve the current problem. The design of ToonTalk and its puzzle game were inspired by Robot Odyssey. The most important difference is that ToonTalk is capable of supporting arbitrary user computations—not just the Boolean computations (AND, OR, and NOT) of Robot Odyssey.

Many computer and video games use puzzles as an effective and fun tutorial. Lemmings and The Incredible Machine are two good examples that inspired the work reported here. Scott Kim (1995) has written about puzzle design and the pedagogic role of puzzles.

In the last 15 years, there have been several attempts to build intelligent tutors that can teach programming (e.g., (Selker, 1994)). This approach has its place in the pool of pedagogic tools but requires a much stronger external motivation for learning programming. The ToonTalk puzzle game is fun—children play it for pleasure, in some case without even knowing that they are learning computer-programming skills.

Discussion

The design and informal testing of a sequence of interactive puzzles designed to teach programming concepts and techniques has been presented. This work raises many questions. Is the technique limited to animated or visual programming languages? Could a similar puzzle sequence be designed for LOGO or Java? How does a puzzle sequence differ from a more traditional problem set?

Let us try to imagine a puzzle sequence for LOGO. The equivalent of the ToonTalk puzzle constraints would be to present the player with "TO", 3 "+"s, a "1", 2 variables, etc. and ask them to compute a number greater than 1,000. Such puzzles might be as intellectually challenging as the ToonTalk puzzles, but probably would be harder and less fun. They would be harder because of a lack of direct manipulation and instant feedback. They would be less fun because it is hard to add the element of narrative and characters that is central to the ToonTalk puzzles. As a result, such puzzles would probably feel more like problem sets. The puzzles in ToonTalk don't just test a student's skills and knowledge, but teach. This is because the student is placed in an environment where they can safely explore a large, but not too large, space of possibilities. And the exploration is immediate—every intermediate step they take has direct, visible, and audible effects.

Future Work

The testing to-date has not been formal and precise. We hope to find and collaborate with another group interested in studying the effectiveness of these puzzle sequences, in a more formal manner.

Other puzzle sequences can be imagined that would teach different computer programming topics, like concurrency, algorithms, user-interface design, and distributed systems. Puzzle sequences can be designed for specialized domains like computer music, game programming, or database programming. The dream underlying this research is that learning hard topics, like computer programming, can be made more effective and fun by borrowing ideas from video and computer games.

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A Multi-Dimensional Analysis of Student Perceptions on Distance Learning

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Key Words: **distance education, Internet-based instruction, asynchronous learning networks, student perceptions, learning styles**

Description

Student perceptions and expectations are important considerations when designing courseware in support of distance learning. This preliminary research project describes one analysis of students' perceptions associated with traditional face-to-face lectures in real time and with Web-based distance learning environments supported by asynchronous communications software. Factors that are often mentioned by student's assessing learning environments include accessibility, flexibility, and interactivity.

This study is the first of a series of studies designed to improve our understanding of how student learners perceive asynchronous learning environments. Two distinctly different sets of graduate professional students are asked their perceptions regarding a fully developed and tested Web-based version of the course they are enrolled in, Library Information Systems. The first set of students (n = 24, Summer 1998) were enrolled in a lecture-based "face-to-face" version of the course, which was supported by Web-based content. The second group of students (n = 36, Fall 1998) were enrolled in an asynchronous learning environment delivering the same course content. A multi-dimensional analysis of the resulting responses provides a means to organize and make sense of the two sets of student responses, as they each examine a three credit hour graduate professional level course offering delivered in an asynchronous learning environment.

Instructors offering or preparing to develop and implement courseware to meet the needs of a distributed and possibly distanced student base need to be made aware of possible perceptions of student learners enrolled in such offerings. Asynchronous communications tools and learning environments in support of distributed learning provide certain advantages to both students and to instructors. Disadvantages also are part of the territory in attempting to create and support student-instructor and student-student interactions. Insights into these interactions can be used to guide instructors as they continue to design, develop, and implement distance learning opportunities.

This study is part of a series of studies that includes assessment of student learning styles and external expert review of the Web-base course offering. Future research centers on linking learning styles with the qualitative perceptions of students enrolled in both face-to-face and Web-based asynchronous communications environments.

General Session: Technology Implementation

Investing Stakeholders in Technology Change: Art or Science?

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Key Words: **technology integration, information technology, technology change, faculty development, instructional design, technology support**

Project Description

Ohio University's Center for Innovations in Technology for Learning (CITL) was established in January 1998 with a $922 grant from the Ohio Board of Regents. Its founding mission was to support faculty development of distributed learning materials for use on and off-campus. The CITL was deliberately placed under the Office of the Provost to insure that it could function in a coordinating capacity. This proposed session will describe the results of the CITL'S first year of operation by focusing on four mission critical activities:

1. The results of an institutional needs assessment based on a survey of instructional technology barriers and supports,
2. A program initiative to address resource allocation in the form of Technology Incentive Packages awarded to faculty on a competitive basis,

3. A program initiative to address faculty technical training and instructional design using information technologies,
4. Statewide participation in the establishment of distance education courses in various media formats.

Like many universities, Ohio University is a highly decentralized organization struggling to integrate technology in a pedagogically sound fashion. In addition, the institution has experienced frequent turnover in its technology leadership, in terms of both management personnel and its organizational structure. Recognizing that a coordinated effort was needed to focus technology support, two deans and one assistant dean spearheaded an effort to obtain state funding to create a core technology service unit. While the move to establish a new organizational unit that addressed institution-wide needs was broadly supported, methods for investing stakeholders were not specified. Consequently, the first task for the CITL's new Director was to begin a process of institutional buy-in among key individuals and departments. The primary means for doing this was to work closely with three groups of individuals: (1) the eight college deans, (2) the three information technology division directors, and (3) the faculty senate leaders.

Attendees will be provided with a framework for assessing institutional needs and detailed strategies for applying data toward institutional change processes. These include: consolidating support and training resources, requiring usability studies for institution-wide Web-resources, and using tuition waivers and graduate assistantships to establish liaisons between departments and tech service units.

Attendees will be provided with suggestions on how to allocate faculty development resources based on criteria that addresses college-level interests. In doing this, strategies for investing stakeholders will be discussed, including selecting examples of best practices based on college-level curriculum goals and enrollment targets.

Attendees will be provided with a matrix for selecting faculty champions willing to work toward developing distance education degree programs.

Spotlight Session: Current and Emerging Technologies

The Digital Tool Set: A Guide to Tomorrow's Technologies Today

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Key Words: **staff development, satellite, Internet, video, digital television, history, distance learning**

As we approach the end of the millennium, it is overwhelmingly apparent that technology will play a vital role in reshaping the way we work, educate, and entertain. Time, distance, and economics are no longer barriers in the way knowledge is delivered. There are powerful, futuristic "tools" that are currently available and affordable. These "tools" can be personalized and accessed by everyone. This presentation features demonstrations of present and emerging Internet, video, computer, and satellite technologies. It begins by taking a brief look at the history of technology and transitions into current and future innovations. Participants explore resourceful ideas for technology distribution and integration into business and classroom environments. They leave with an understanding of how the new digital tool set impacts the delivery of information and facilitates learning.

John Kuglin uses his 25 years of experience as a classroom teacher, district technology director, Senior Director of Technology for McREL (a U.S. Department of Education research and development lab), and senior management positions for two telecommunications companies (TCI, ACTV), to bring the audience this unique perspective on technology.

Topics include:

- A brief, but fascinating look at the history of the personal computer.
- Understanding the elements that constantly fuel the ongoing information explosion. This includes the latest developments in processor speeds, storage media, and transmission technologies.
- The use of satellites in education. This includes using NASA educational programs as they pertain to the EOS project. Topics will also include the delivery of Internet content via direct and cost-effective satellite transmission.
- A discussion of key Internet sites. Each of these sites represents an example of the stages a learner could expect to experience in a typical Internet learning process. The process usually begins with understanding the role of an Internet portal, and ending with developing a personal Web site.
- Understanding the elements of successfully implementing a distance learning program. This includes identification of learning containers, streaming media, and synchronized delivery of voice, animation, and text to form exciting new learning opportunities.
- Understanding the digital television revolution—the convergence of the personal computer and the traditional television set. Discussion will surround the national roll-out of digital television and the move to HDTV. Points of discussion include superior picture and sound qualities, as well as the ability to multiplex digital signals. This allows exciting new learning opportunities in the future.

A Multidirected Approach to the Integration of Technology in Education

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Key Words: **project based, staff development, multicomponent collaboration, cutting-edge, Internet**

The Bergen County Technology School (BCTS) district is an adventurous leader in the use of technology in the educational process. Long-term vision and partnerships are combined with a multi-thrust cutting-edge approach in the areas of technology, training, teaching, and learning. A challenging, project-driven curriculum is technology infused, collaborative, interdisciplinary, and learner-centered. National and international educational leaders visit the district; partners include local and national institutions and technology corporations; higher education institutions seek collaborations; and district and teacher training Web sites have won competitions and are visited 24 hours per day. The BCTS (www.bergen.org) district is well known for its ability to integrate technology into the finest education product.

We shall use a Civil Rights (www.bergen.org/civilrights/) project to demonstrate the need for meshing an educational and technology vision; partnerships in the technology and content areas; the latest in technology equipment and infrastructure; teacher training and collaborations; and teacher freedom to develop and demonstrate models and pilots. In this team presentation, we shall demonstrate the multiple components necessary for technology literacy and lifelong learning, featuring several speakers and high technology demonstrations to show the integration of administration, faculty, technology, and partners in the art of the possible, as well as a hint of the future.

Components to be addressed are:

- The vision and energy of a leader, and a clear institutional "can-do" mission for a new way of doing business. Technology and educational leaders and faculty at BCTS are given professional carte blanche to carry out a new integrated, cutting edge curriculum, and the ability to test pilot activities.

- Partnerships: corporate, educational, parent and local community partners are excited to join the enterprise. Importantly, too, faculty, partners and administration constantly team up to develop new collaborative technology-integrated projects, to show new possibilities.

- A project-based learner-centered curriculum. Projects are done as the culminating or ongoing daily activity. For instance, in the Civil Rights project, a class is divided into groups and students take on the roles of certain leaders, after using the computers to access the class Web Page for research. The overall goal of this project is to answer the question: How can people resolve conflict through peaceful, political, and legal means? As the Civil Rights Home Page states: The culminating "R tele-talk show activity will run much like the talk shows that are so popular today (i.e., Oprah Winfrey, Geraldo Rivera, etc.)." Students from several schools will be able to take part and participants will be able to share video and audio clips via the Internet.

- Teamwork is key at BCTS, to prepare students for the future workplace: one half day of each week is devoted to all-class multidisciplinary projects, such as designing and marketing a new detergent or creating a self-sufficient house. Teams might plan, market, do scientific research or Web development, or create 3-D animated designs. Senior students leave the campus one day of each week and work in businesses or medical facilities in the metropolitan New York area. They may also do scientific research on or off campus (and this is real published research). Civil Rights students may also create their own video segments.

- Cutting-edge technology. The realvideo server and large Avid drives support management of video and animations; computers are in all classrooms. A strong partnership with Bell Atlantic has enabled BCTS to pilot and demonstrate the power of the latest ATM technology, not only in BCTS but also for all Bergen County and New Jersey, providing fast parent and community access.

- Staff development. As part of Bergen Educational Technology Training Center's (www.bergen.org/ETTC) Three-Step Plan, stipends from Bell Atlantic have enabled some county teachers to become Project Facilitators (Step Two of the Plan) to develop model projects, train other teachers, and then support them with Discussion Boards. (Step One is a three-day course, Step Three is participating in online courses.)

The Virtual High School—Up Close and Personal

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Key Words: **online courses, 9–12, staff development, distance learning, Internet, curriculum development, virtual**

The Virtual High School Collaborative, which is funded by a five-year Department of Education Technology Challenge grant, is delivering high school, Advanced Placement, and college courses via the World Wide Web to Grade 9–12 students across the U.S. (It can be visited at its Web site, http://vhs.concord.org/.) In its second instructional year, this project of the Concord Consortium and the Hudson Public Schools is offering more than 40 courses to 800 students in urban, suburban, and rural public and private schools. Next year, 110 courses in an array of subject areas will be offered to more than 2,000 students in 16 states and abroad.

Student courses are taught asynchronously, using posted, threaded, online discussions. VHS teachers are prepared by means of an online graduate-level course on how to author instruction using Lotus LearningSpace software, which the project employs. For each participating net teacher, a school is given 20 student spaces in any netcourses offered, so long as students meet course prerequisites. Each school must also provide a Site Coordinator to oversee students and handle logistics. Registration is online. Maximum class size is 20.

The project intertwines curriculum reform and technology implementation in a way that can greatly assist school reform efforts. Netcourses resemble seminars, and include student collaborations created over the Internet. Discussions and projects are archived on Web sites where teachers and students create shared knowledge spaces. The role of the teacher is to plan and guide the discussions and projects, to provide resource materials, to intervene when a strategic comment will help students learn, and to evaluate student performance.

Panelists are all participants in the Virtual High School, who share a sense of adventure, a taste for innovative and exciting methods of instruction, and a belief in the value of integrating new technologies in education.

Daniel Drew, who instructs the VHS course, American Music Heritage, was one of the first music teachers to establish a MIDI lab. Bruce Droste, Director of the Virtual High School, previously worked with Senator John Kerry (MA) to found Second Nature, Inc., a nonprofit organization incorporating environmental principals in university curricula, and was founder and Headmaster of the Atrium School in Watertown, MA. Staci Kalmbacher, a VHS Site Coordinator, was one of 40 educators chosen by NASA to research and develop the Classroom of the Future. Bonnie Killian, teacher of the netcourse, Business in the 21st Century, is Program Associate and Technology Coordinator for the North Carolina REAL (Rural Entrepreneurship through Action Learning) enterprises after two decades as a Business and Computer Applications teacher. English teacher Jerry Lapiroff, Site Coordinator at a school currently restructuring as a Multimedia/Technology magnet, was a Dow Jones Newspaper Fund Distinguished Journalism Advisor and spent a year in England on a Fulbright Exchange.

General Session: Curriculum and Instructional Strategies

Algebra and Technology—Deep in the Heart of Texas

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Key Words: technology, mathematics, data collection, Internet

Teachers from the different school districts work together changing the philosophy and teaching of algebra, as it becomes the common denominator of all math courses in the secondary level.

Funded through a Challenge grant from the U.S. Department of Education, teachers in San Antonio, from two major public districts along with a sector of the private schools, are developing new lessons that incorporate technology in Algebra I. Some of the technology incorporated in the curriculum includes graphing calculators, probes, computers, and software.

Learn how to collect real-time data to bring the Algebra I curriculum back to life. Learn how to use the Internet as a research library for data collection, use probes to collect real-time data, import the collected data in the computers, and use the power of algebra to make interpretations of real events. As technology becomes more readily available, the scope and sequence of algebra requires an overhaul in its methodology and instruction.

Topics discussed include:

- A new philosophy and methodology for Algebra I
- A redesign of the scope and sequence of Algebra I that incorporates technology
- Sample lesson used by teachers in the SATEC program
- Future of the SATEC grant and the mathematics curriculum

General Session: Curriculum and Instructional Strategies

Primary Students Publishing Research in HyperStudio Templates

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Key Words: **primary research, project based, project, HyperStudio, technology integration**

First graders conducting authentic research and publishing in HyperStudio? It can be done! Leave with tons of materials to help implement technology-facilitated research in your classroom.

This is a project I have facilitated for the last three years in first grade classrooms in our building. The project takes place towards the end of the year, when the first graders' reading and writing skills have been more fully developed. The project begins with the students choosing a topic with teacher and parent input, under the umbrella of a larger unit concept, to research. The students, in the context of assessed prior knowledge, choose a specific focus, or burning question, to guide their initial research. Many different types of information resources, both electronic and traditional, are used by the students to find information on their chosen topic. The subtopic list is generated during a whole class discussion lesson, relying on student input. Through modeling and direct instruction, the first graders are introduced to obtaining and processing information from pictures, text sources, and videos. This is a very difficult process to learn, especially in the first grade. We have had great success, however, in teaching the kids how to put the information in their own words. Using specific examples, I will show in this session how we teach the first graders this process. We begin with pictures and move on to video and text sources, using organizers and constant monitoring, and reteaching with minilessons wherever needed. Several stations are set up around the room where the students take notes using their organizers. The stations include the video station where the students take notes from a video on their topic; the computer stations where the students take notes from a picture or text on CD-ROM, the Internet, or other online service; and several research stations where topic-related traditional materials are available for reading and notetaking, such as books, magazines, and encyclopedias. Other stations include the video capture station where a camcorder is connected to a computer to digitize pictures of the student project artwork, and the final assembly station where the students place all of their information and pictures into the HyperStudio template.

Whole-group and minilessons are used in conjunction with individual instruction to prepare the students for the process. The students take an active part in the formation of the performance rubric and each child presents their project using a computer projector.

In this session, I will discuss and show specific examples of how this entire process is facilitated and managed in a first grade classroom. Through video clips, examples of student work, and anecdotal stories, participants will leave with a solid understanding of how to implement such a research project in a primary classroom. Detailed instructions on how to use the HyperStudio templates, descriptions of the classroom stations, teacher informational handouts, student blacklines, student project examples and the HyperStudio templates will be shared during the session and are currently available on the Web. These will be updated as we do the project again this year with our first graders.

Elementary Technology Integration from a Shared Perspective Principal, Teacher, Technology Teacher

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Key Words: **technology program planning, curriculum integration, teacher support strategies, staff development**

Why reinvent the wheel? This session will provide participants with the direction and tools needed to integrate technology across the whole school program. We will share the planning process, teacher support strategies, integrated technology curriculum outlines, and kindergarten through fifth grade software lists that we have developed and implemented to create a schoolwide technology program for our elementary school.

Student projects and lesson plans will be on display. A handout featuring our technology curriculum, software lists, integrated units, and assessment tools will be available. Most importantly, the principal, classroom teacher, and technology lab teacher will share the ideas and strategies they used to develop and implement a schoolwide technology program.

Here is an outline of the program we intend to follow:

Discuss the Planning Process

1. Share teacher support strategies that ensure ownership of the program.
    - Discuss our Technology Staff Development Initiative (our district was awarded the Pennsylvania Outstanding Technology Staff Development Award).
    - Discuss strategies we have in place to promote teacher ownership of the technology program.

- Discuss our team teaching model for integrating technology across the curriculum and whole school program.

2. Share a valuable handout of program outlines and lists:
    - Technology Curriculum—skills blocks that we have identified as essential technology skills for elementary students
    - Suggested software lists for kindergarten through fifth grade program
    - Integrated units and assessment sheets
3. Share a brief video showcasing technology at work in our school:
    - IBM Writing to Read Program at work
    - Closed-circuit video production facilities with daily morning announcements and special features
    - Mac Lab, designed to facilitate cooperative learning
    - Classroom developed technology projects

General Session: Teacher Education and Training

The TEbase connection: Facilitating Technology Instruction for Preservice Teachers with Web-Enabled Databases

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Key Words: **teacher education, technology standards, Web-based interaction**

As electronic resources for learning become increasingly important to schools across the country and around the world, technology instruction is becoming a major responsibility of preservice teacher education programs. Too often, it is still an unmet challenge, owing to lack of time in the curriculum and unclear instructional focuses. Curriculum restructuring is an important step on the road to reform. A new curriculum for teacher education at a large midwestern university answers the challenge by infusing a technology focus into all its courses, and by linking class activities to both national standards and preservice teacher placements.

Technological and instructional innovations play an important role in the revised curriculum. A set of Teacher Education Databases (TEbases) is a key component. The instructional key to coordinating efforts across courses is a "virtual course" called "Content Area Applications of Educational Technology." The course has no scheduled meeting time or place but its instructor provides instructional activities and feedback to students via the World Wide Web.

The instructor also coordinates closely with the students' other teachers, so that technology instruction receives balanced attention throughout the curriculum. Assignments are tied closely to the content-area teachers' instructional focuses, and to the 18 Foundation Standards for technology set by the National Council on Accreditation of Teacher Education (NCATE). This technology course is required for approximately 500 junior and senior-year students in the elementary and secondary teacher education programs.

This presentation will describe how the TEbases support the course. Audience members will have an opportunity to play the roles of faculty and students interacting via a TEbase. As students, they will complete short assignments and indicate how the assignments relate to technology standards. As faculty, they will assess and respond to students' submissions.

This presentation will be of primary interest to audience members involved directly in teacher education. Those interested in curriculum strategies, using technology to facilitate learning, emerging technologies, and technology implementation will also benefit.

General Session: Teacher Education and Training

The New Internet without Blood, Sweat, Tears, or Lawsuits

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Key Words: **Internet, instruction, tutorials, training, testing, liability, Web, e-mail**

This session introduces a complete, updated program of Web and e-mail instruction using your Web browser to teach Internet skills without an Internet connection.

Whether you deal with elementary or secondary students, you will leave with:

- an understanding of the greatest potential liability issue you face,
- a complete, five-step plan for safe and easy Internet instruction,
- a simple but comprehensive generic acceptable use policy,
- a Student Internet Use Agreement, and
- a sample Parent Internet Permission Form.

As a school librarian given the task of granting Internet access to over 1,000 students, Patrick Lewis had to find a way to automate the teaching of Internet skills, provide supervised access to the Net, and at the same time avoid the legal problems that could result from unrestricted Internet use. To accomplish this, he and colleague Allen Armstrong developed a Five-Part Plan for granting student Internet access. The plan addresses the issues of instruction, testing, acceptable use policies, supervision, and discipline.

Because Internet instruction poses the biggest problem for most educators, this session will deal extensively with two programs developed by Lewis and Armstrong. The first version of the Grade 8–12 program, The Information Superhighway Driver Training Course, was introduced at the American Association of School Librarians Convention in Portland in March of 1997. Bicycle Safety on the Information Superhighway, for students in Grades 4–7, was demonstrated at the American Library Association convention in July 1997. The 1998 versions of both programs were first presented at NECC '98 in San Diego to an enthusiastic overflow audience.

Running in your choice of either Netscape or Microsoft Internet Explorer, these self-paced Internet training courses put students in the driver's seat for a safe journey through the twists and turns of the information superhighway. In the Web section, each CD-ROM has six active captured Web sites with particular appeal to students. In this controlled setting, students learn to navigate the main roads, as well as the back roads, of the Internet and World Wide Web. In the e-mail section, students learn netiquette, the rules of the road, and master one of three mail programs (Eudora Light, Netscape Mail, or Pegasus Mail).

This presentation will bring together all five parts of the plan to introduce attendees to a complete, four-hour Internet instruction program that has been used to put thousands of students throughout the U.S. and Canada online without blood, sweat, tears, or lawsuits.

EnviroNet and HealthNet: Asking Questions, Exploring Answers Using Online Data

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Key Words: **K-8, curriculum, classroom applications**

Engage your students in scientific discovery, analysis, and interpretation by using student-generated health and environmental online data from HealthNet and EnviroNet.

EnviroNet and HealthNet are existing electronic networks from Simmons College of teachers, school nurses, students, as well as environmental and health professionals who use telecommunications and scientific monitoring projects to integrate math, science, language arts, and health education. Each year, hundreds of classrooms collect data locally on such environmental parameters as acid rain, visits to a school bird feeder, roadkill, and bats, for EnviroNet. Others collect health behavior data on hygiene, exercise habits, tooth care, and dietary choices for HealthNet. All of this rich data is available through the EnviroNet and HealthNet Web sites.

This session will demonstrate how to collect, access, and use data from both sites as the basis for learning activities in math, science, health, and language arts. Specific applications for elementary and middle school classrooms will be shared. This session will be tailored to K-8 teachers with beginner to intermediate experience in technology use.

Both presenters have worked with over 500 teachers, school nurses, and administrators from New England, training them to use HealthNet and EnviroNet in their classrooms. The two presenters, a biology instructor and an education professor, model collaboration between science, health, and education which enables them to teach science content within the framework of relevant curricular applications.

The EnviroNet Web site can be found at http://earth.simmons.edu/. The HealthNet Web site can be found at http://sun.simmons.edu/healthnet/.

General Session: Using Technology to Facilitate Learning

How to Use Basic Computer Applications to Achieve Higher-Order Learning

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Key Words: **computer as a tool, inquiry, higher-order thinking, lesson plans**

Rationale

Recent research results indicate that student achievement can be hindered when computer use is limited to engagement with drill-and-practice software programs that are not directly linked to and supplemented with classroom instruction (Archer, 1998). Therefore, it is critical to engage students in computer activities that foster and develop higher-order thinking and learning. Although there are many expensive educational software packages that provide engaging environments, their focus is often very limited and they typically do not reflect what students will experience in the workforce. A viable alternative is to have students use basic computer applications, such as databases and spreadsheets, to solve realistic, meaningful problems.

Purpose

The purpose of this presentation will be to share ideas for developing lesson plans that use integrated software packages, such as ClarisWorks, Microsoft Works, or Office to engage elementary through high school students in higher-order thinking activities.

Content

The presentation will begin with a rationale for moving student use of computers to deliver instruction (e.g., drill-and-practice and tutorials) to using the computer as a tool to solve authentic problems. A lesson plan template that assists teachers in each step of development will be shared (Lowther, 1998). As each step of the lesson plan is explained, concrete examples will be used to reinforce the concepts.

A key component of this lesson plan, that varies from non-computer lesson plans, is determining which computer functions can be used to help students attain the specified learning objectives. The participants will be shown how the computer can be used to develop higher-order thinking skills by using computers as tools for inquiry. The functions include various ways to process information, such as sorting, matching, charting, linking, searching, etc. All of these require the student to process information prior to going to the computer, while at the computer, and after they get the computer results. The presentation will include ideas for developing interesting and authentic problems that require the students to attain the specified learning objectives while reaching a solution. Participants will be shown how the problem-solving process also reinforces basic skills in language arts, reading, math, etc. The participants will be provided with numerous lesson plan examples of this model and handouts that include a lesson plan template that has room for teachers to fill-in each category.

The lesson plan and overall approach being presented is based on the iNtegrating Technology for inQuiry Model (NTeQ—pronounced "in-tech") (Morrison, Lowther, & DeMeulle, 1999). This model is successfully being used in a variety of preservice and inservice teacher education programs across the nation.

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General Session: Laptops

Standing T.A.L.L. with Laptops in the Classroom

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Key Words: **staff development, laptops, curriculum, classroom infrastructure, support**

Attendees will acquire an overview of a successful and established implementation of laptops in a small, rural, public school district. When they leave the session, they will have an idea of the benefits and challenges when a school district evolves from a non-laptop school to a fully integrated laptop program.

The presentation will be divided into three main parts. The first part will consist of the background of the school district, the staff development program, and the implementation plan. Teaching And Learning with Laptops (T.A.L.L.), a program initiated with students in Grades 5–9 is an outgrowth of the district's technology plan. The district believes that technology is a tool to be integrated within all curricula and therefore needs to be available for teaching and learning at anytime, anywhere. Productivity software such as word processing, presentation, database, and spreadsheet applications should be the primary tools of today's classrooms as the paper and pencil have been to classrooms in the past. In order for this to happen, the technology tools must be flexible and compact enough to fit into the confines of current classrooms, but have the mobility to be utilized anywhere. We believe the T.A.L.L. project demonstrates that providing every student with a laptop computer is a practical solution for meeting this challenge. The staff's commitment to action has been built through several on-going efforts to elevate their technological abilities. In conjunction with the laptop program, the district reached an agreement with the teacher's association whereby the school would provide laptop computers to teachers who agree to attend inservices focusing on integrating technology. The district believes in the train the trainer concept of staff development. Over the past four years, teachers have been offered a variety of inservices on productivity tools as well as curriculum integration programs taught primarily by their local peers. In the last two years, over 250 hours of staff development opportunities in technology have been provided in the district.

The second part of the presentation will detail the physical transformation of classrooms and the necessary support and maintenance to facilitate the program. Each room is configured with a minimum of 24 data ports connected to a switched hub that allows all students in the class to connect their laptops and have simultaneous access to the file server, printers, and online resources such as networked CD-ROMs and the Internet. The rooms also are equipped with 36" monitor/receivers and scan converters that allow participants to display computer information to the entire class. All classrooms have accessibility to digital cameras, scanners, visual presenters, and video projectors.

The last section will be presented by faculty members who will discuss how their experiences have reshaped their thinking about education. T.A.L.L. philosophy is stimulating changes in the way classroom tasks are performed. Teachers are becoming facilitators of learning rather than disseminators of information and learning is becoming more student-centered and individualized. Classrooms that were formally arranged in rows now are positioned in patterns that allow easier teacher-to-student and student-to-student interaction. Classroom assignments are more project-based with greater integration of curricula. Students who were formerly confined to the limited research offerings of the school and village libraries now have a wealth of worldwide resources right at their fingertips. Science lessons that previously used data five or more years old are now using up-to-the-moment information.

General Session: Social and Ethical Issues

Bringing the Internet to the Inner City

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Key Words: **Internet, NASA, minority institutions, interdisciplinary research**

"Bringing the Internet to the inner city" describes the activity of an innovative NASA MU-SPIN sponsored program, for developing and sustaining infrastructure and connectivity at under-represented institutions. The program, designed to stimulate the use of the Internet via computer networks as an integral part of minority institutions' interdisciplinary research and education, has completed its third year with exemplary results. Administered by the Morgan Network Resource Training Site (NRTS), participating schools have come from no access (in many cases) to completely functioning multimedia laboratories enhancing science, engineering, and mathematics studies and participating in nationwide NASA programs. The program is complete with a vigorous training component to ensure both its continuance and growth.

The Morgan NRTS is responsible for building and maintaining Internet connectivity to minority institutions and predominantly minority attended elementary and secondary schools, and providing training in network implementation, operation and usage, to faculty, staff and students at these institutions. In order to achieve these objectives, the Morgan NRTS had to first bring the networking capabilities of its own campus up to the established guidelines. The first year of the program saw the lead institution accomplish that with the establishment of several computer laboratories and high-speed connection to the Cray supercomputer with net access via a 10 Mb SMDS service.

The second year of the program was highlighted by the installation of the first increment of eight multimedia workstations in each of the participating schools, as well as installation of ISDN lines for net access in each. There were two major workshops, one each semester, to provide in-depth training to members of the faculty as well as several specified training sessions for curriculum development.

The third year consisted of intensive training for each of the schools, enabling them to not only incorporate the use of the Internet in their courses, but also to branch out to other schools and programs in which the new infrastructure permitted participation. The overall effect was to expand greatly the scope of coverage as well as involvement. There were several collaborations that developed, stretching the influence of the program even further.

As we advance to the fourth year, the NRTS initiative thrust is to incorporate the use of the infrastructure to embrace other NASA interest programs and to utilize the capability that now exists in the participating schools to the best advantage in as many outreach programs as practical, in support of science, engineering and math studies. The collaboration with the ACE program, Al J. Bra interactive educational tool, 3-t mentor program, and the Earth cam project are examples. The fourth year will see the completion phase of all participating school laboratories, increased training on-site, and expanded outreach involvement.

General Session: Curriculum and Instructional Strategies

CongressLink: Using Internet-Based Technology to Teach about Congress

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Key Words: **Congress, government, civics, social studies, Internet, education**

CongressLink (www.congresslink.org) is the center of an online learning community for teachers, students, and learners of all ages. It is committed to exploring new ways to learn about Congress, how it works, its constitutional underpinnings, its leaders and members, and the public policies it produces. It is a place in which all members can bring new information for analysis and amplification, and where new application of knowledge can be envisioned and implemented.

CongressLink focuses on serving teachers and students in schools. It employs innovative, technology-based approaches to instruction and cutting-edge services for teachers that enhance civics education in the schools. These resources are being designed in cooperation with teachers of American government, American history, and civics, to address current trends toward student-centered, research-based, authentic curriculum. CongressLink serves as a laboratory within which to explore the new information technologies as tools for learning and for gaining a deeper understanding of Congress, the Constitution, and how they work.

During the CongressLink session, presenters will describe and demonstrate the features of CongressLink: fully developed lesson topics related to the history and operation of the U.S. Congress, suggested student activities, access to subject matter experts, links to related Web sites, and online tools for collaboration. The panel will also explore the learning objectives envisioned by the site developers and evaluate their success in achieving them.

General Session: Social and Ethical Issues

Project FOCAL Point: Focusing on Gender Equity

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Key Words: **gender equity, computing, teacher workshop, computer camp for girls**

Project FOCAL Point is a multistrand project encompassing several models that have been shown to be effective in encouraging girls and young women in non-traditional fields. The project's overarching goal is to increase female participation in the computing sciences.

As early as middle school, computing comes to be viewed as a "nerdy" male activity. Girls just do not see themselves as belonging to the computer culture. Hence, many elect not to take secondary or college-level computing courses. As a result, qualified girls and young women unknowingly exclude themselves from potentially lucrative computing careers. The nation suffers, too. Currently, there is a critical shortage of information systems professionals. We cannot afford to have a major source of talent remain largely untapped. Project FOCAL Point seeks to get more females in the educational pipeline by working with two crucial groups: high school computing teachers and high school girls.

The project's initial activity is a two-week summer workshop, open to junior and senior high school computing teachers nationwide. During the first week, teacher participants receive instruction in gender and other computing issues, Internet use, programming languages, and information systems concepts. They also begin developing female-friendly technology lessons. During the second week, the teacher participants pilot test their lessons with female high school students in a Computer

Camp for Girls. Panels of information systems professionals acquaint teacher and student participants with the computing career opportunities available to women.

The University of Wisconsin—Stevens Point awards each teacher participant three graduate credits for their participation in the project. Moreover, each teacher participant is eligible to receive a $500 mini-grant with which to initiate a gender-related computing project in his or her home school or community. To sustain interest and commitment, the teacher participants will join a virtual community (via the Internet). Participants will reconvene for a two-day conference during the summer of 2000, where they will share their triumphs and lessons learned and get re-energized.

The general session presentation will share the goals and objectives of the project, elaborate on the project activities, report on the outcomes of the project's inaugural season (summer 1998), describe progress on the current mini-grant projects, relate plans for the summer of 1999, and provide Internet links to all aspects of the project. Participants interested in developing their own gender initiatives could build upon any one or combination of the project's multiple strands.

Major funding for Project FOCAL Point is provided by National Science Foundation Programs for Gender Equity, grant HRD-9711023.

General Session: Curriculum and Instructional Strategies

Multimedia Design: Teachable Moments

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Key Words: **multimedia, student projects, teachable moments, Macromedia Director**

Several years ago, the Rutherford School District created a multimedia laboratory that was designed to allow students to explore multimedia in a full-year course. The course was developed as a joint effort by several students in a computer independent study mode, a teacher, and the supervisor of computer technology. The course has evolved over the years, adding new software and updating equipment. It is now one of the most popular courses in the school.

Students learn how to use Photoshop, Premiere, Morph, and tie it all together using Macromedia Director. They begin with easy topics, make their own MTV movie, and finally create a teachable moment. The teachable moment is created with the cooperation of a classroom teacher in a course they are presently taking. These students do research and use everything they have learned to create an extraordinary lesson. At the end of the year the lessons for the same departments are all pressed onto CD-ROMs and used by the teachers in subsequent years.

The success of the program is seen in the very creative and practical projects the students have made, and the number of teachers who have become more interested in multimedia and computer projects.

General Session: Curriculum and Instructional Strategies

On the Road Again

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Key Words: **staff development, Internet, curriculum, training, classroom applications**

The "On the Road Again" session will begin with a multimedia slide show that guides teachers through the steps of producing an IRL, "Internet Resource Lesson." The student-centered lessons will use Internet sites to incorporate learning standards through multidisciplinary themes. The presenters will provide K-8 teachers a framework for thinking about producing their own Internet Resource Lesson—no matter what grade level or curricular area, no matter what teaching style.

Topics will answer the following questions:

- How do I start?
- What will I need?

- How do I find what I need?
- How do I manage it all with one computer?
- Who will help me if I have a problem?

During the session, participants will obtain: (1) flexible ideas to use Internet in the classroom situation, (2) a packet of useful information that not only lists appropriate theme-based Internet sites, but also practical ways to use the sites, and (3) sample Internet Resource Lessons that may incorporate other popular pieces of software. Coordinators will be able to recognize an easy-to-replicate staff development workshop that can be implemented with few resources.

General Session: Curriculum and Instructional Strategies

Using Online Primary Resources in American Memory

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Key Words: **primary source materials, online resources, American history**

In 1994, the Library of Congress launched the National Digital Library Program, a public-private partnership between the United States Congress and private donors. The purpose of the program is to make the rich primary sources from the holdings of the Library of Congress available via the World Wide Web. Called American Memory, the site includes over 50 collections, with more additions being made monthly. The vast number of materials within these collections includes photographs, maps, sound recordings, motion pictures, and documents, all which help to tell the story of America. The use of such a wonderful and enormous resource can be daunting. The purpose of this session is to provide a general overview of American Memory and to introduce session participants to the tools provided online which assist teachers and students in using these digitized historical collections.

Session participants will be given a guided "tour" of the site, showcasing a few highlights of the collections. An important part of American Memory is the Learning Page, which provides a variety of information and tips to aid users. For example, teachers can find lesson plans using primary sources from the collections, students can find activities which are an enjoyable introduction to American Memory, and feature presentations help users to explore particular themes. These support materials are meant to facilitate ease of use of the collections, as well as promote critical thinking, heighten visual literacy, expand vocabulary, and strengthen information literacy skills.

Following the "tour" of American Memory (20 minutes) and the Learning Page (20 minutes), the floor will be opened for questions from session participants (20 minutes). Brochures containing descriptions of the online collections will be provided.

General Session: Staff Development

Phased, Not Fazed

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Key Words: staff development, technology training, recognition, integration

Kennedy Elementary has developed a plan for the professional development of faculties at any level of education. Divided into phases, the plan focuses on many aspects of teacher improvement.

As is the case with most schools around the country, technology in our school has changed dramatically in the past five years. Expectations of teacher knowledge in technology have increased, but often the answer to how to move the staff to a level of comfort with the subject is elusive. Six years ago, Kennedy Elementary School in Houston, Texas, had a student population of over 900, an Apple IIe Lab, and 11 Macintosh computers. All of the Macs were allocated to the fifth grade on the theory that the older students could make the best use of them. During the 1993-94 school year, a change in administration occurred at Kennedy and teachers were asked to fill out a survey about their technology needs. What the survey revealed was a tremendous amount of stress and anxiety. The staff knew that they needed to incorporate the technology into the curriculum, but did not know how. The school's principal and technology specialist decided that a dramatic shift in support for teachers was needed.

The result was a comprehensive plan for the professional development of the school's faculty. Three years later, the Technology Phase Plan's success has resulted in its being chosen by Compaq/Scholastic as the National Model Gold Medal Winner and Ambassador Award Winner in their Professional Development Grant Program. The Phase Plan divides a teacher's technology knowledge and expertise into five phases. Teachers complete tests or surveys and performance tasks after each phase, receiving assistance until they have mastered each section. The plan encourages teachers to become technology-literate at their own pace. The five phases of growth range from basic skills to multimedia presentations, appropriate use of the Internet, and classroom applications. In support of the teachers, Kennedy has created a technology training program, which focuses on the staff's needs at any given time. In one year alone, teachers had access to 140 staff development sessions in technology—all as an integral part of an extensive, constantly evolving staff development program focusing on many aspects of teacher improvement.

The plan is appropriate for use at any level of education or business. Since the publication of an article in *Electronic Learning*, we have had requests for information and presentations from elementary schools, high schools, and business firms. Attendees at the session will receive a comprehensive overview of the plan and suggestions on adapting it for their own use.

Kennedy Principal, Mary Hosking, co-wrote the Phase Plan with Kelly McBride, Kennedy's Technology Specialist. They have been facilitating the plan's implementation and collecting data on the results for the past three years. Hosking has been working with Technology for several years, serving as a Technology Specialist before becoming an Administrator. McBride has been working in her position for four years. As a campus-based Instructional Technology Specialist, her job is to facilitate integration into the curriculum by model teaching and working with each individual teacher in his or her professional growth.

Spotlight Session: Teacher Education and Training

New Horizons: New Schools for the New Millennium

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Key Words: **accelerating change, new technologies, new paradigm**

By now, most people have realized that the world is no longer the stable and predictable place that it once was. But just how fast is the world moving? There are many who are saying that the changes in the next 10 years will dwarf those of the last 50. What impact will this changing world have on education? And how can educators plan effective curriculum in an environment of accelerating change? This presentation examines some of the major new technologies that will fundamentally change the world in the next 10 years, explores the shift in curriculum and thinking that will be necessary to equip students for success in the brave new world of the 21st century, and identifies what this signifies for communities. How can schools prepare for this world? Perhaps by focusing less on technology and more on information and new mindsets for those in the workplace. Participants should come prepared to have many of their present assumptions about education challenged. Counseling will be provided.

Topics:

- Moore's Law
- Living in the future tense
- Ten attributes of a new paradigm of schools
- Shifting to focus on process skills, not just products
- New process skills that we must teach

General Session: Technology Implementation

The Ohio Literacy Resource Center's Technical Assistance/Training Network

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Key Words: **technology implementation, staff development and issues, training network, technical assistance**

As the 21st century approaches, it is imperative that individuals in the education arena, have a wider perspective on the pros and cons of creating and implementing any type of technology support program for their school board, district, organization, or agency. The Technical Assistance/Training Network is a pilot project supported by a 353 grant from the Ohio Department of Education and coordinated through the Ohio Literacy Resource Center. This pilot project provides "free" on-site technical support to Ohio's Adult Basic and Literacy Education programs, administrators, staff, teachers, and volunteers. Networks of regional trainers have been hired to conduct on-site training in four- or eight-hour increments. This presentation will allow the participants a chance to discuss and evaluate several issues necessary for incorporating a technology support team or staff in their educational arena.

In addition to covering the initial implementation process, its current and future state of the program, the presentation will provide a detailed overview of the pilot project.

The detailed overview of this pilot project will include:

- The primary purpose of the Technical Assistance/Training Network
- Current procedures of the Technical Assistance/Training Network
- How the Technical Assistance/Training Network can provide free on-site technical support to local programs and practitioners throughout the State of Ohio
- Funding issues
- Hiring procedures of the technology consultants
- How the coordination and organization of the project has been conducted, to date

General Session: Curriculum and Instructional Strategies

Weaving Technology into Your Standard Curriculum and Evaluating the Results

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Key Words: **rubrics, Internet, classroom applications, electronic fieldtrip**

Technology + Standard Curriculum = Success! Learn how to weave technology and assessment seamlessly throughout the disciplines. Rubrics, URLs, and handouts you can use tomorrow!

Is it really possible to include technology into a typical day packed with standardized curriculum, achievement tests, and accountability? See the exciting solutions provided by an interdisciplinary team of math, fine arts/history, and language arts teachers. You will explore selected Web sites and learn techniques for using the Web to teach. This session is truly where the real rubber meets the virtual road! You will learn:

- How to develop a lesson beginning with a curriculum standard
- How to help students interact meaningfully with some of the best math, art, and history content on the Web
- How to evaluate student progress during Web research and interactive lessons

How can teachers be sure student Internet treks are meaningful? How can you keep your students engaged and focused on sound content, rather than the many distractions on the World Wide Web? What constitutes success? How do we help students sort through the information glut on the World Wide Web?

You will find answers to these important questions and much more in this interactive session conducted by Caroline McCullen, former National Technology Teacher of the Year and author of "The Electronic Thread," a technology column in *Middle Ground*, the National Middle School Journal. Learn about simple tools and techniques that teachers can use to assess the quality of student work. Learn how to monitor and evaluate student progress using methods based on recent research. See examples of effective products and portfolios posted on a variety of school home pages.

You will receive Web addresses of pages where you can find free rubrics, spreadsheets, assessment tools, templates, and other resources for your classroom. You'll learn innovative techniques for weaving technology and assessment seamlessly throughout the disciplines.

Participants will be taken on an electronic field trip to MidLink Magazine, the award-winning digital magazine created "by kids, for kids." The magazine is filled with a variety of research projects, classroom activities, interactive projects, and multimedia designs created by middle school students from locations that span the globe.

This session will also touch on the troublesome issues of copyright and electronic publication of student research. You will receive templates, handouts, rubrics, and URLs directly from wired classrooms across the nation. You will leave this practical session with tools you can use in your classroom tomorrow!

Note: Handouts are available in the Teacher Resource Room of MidLink Magazine: http://longwood.cs.ucf.edu/~MidLink/.

Society Session: Curriculum and Instructional Strategies

Multimedia Mania!

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Key Words: multimedia, standards, integration, contest, curriculum

Technology + Curriculum = Multimedia Mania! HyperSIG's International Multimedia Contest winners present their amazing work. Projects are effective, working models of skillful technology integration. A limited number of free CD-ROMs containing the winning projects will be available at the booths of sponsors: SAS Institute, Roger Wagner Publishing, and Macromedia.

ISTE's HyperSIG will honor winners of this international multimedia contest. In January, 1999, teams of students and teachers from all over the world were invited to select a multimedia tool and design an interactive project which will enhance the learning process. The contest is designed to challenge students and teachers to use the latest multimedia techniques to address instructional goals and curriculum standards.

All projects are subjected to rigorous review by an international panel of judges. Winning projects were evaluated by a rubric that emphasized content, screen design, program design, originality, documentation of sources, and relation to curriculum. The contest results will provide effective working models of multimedia projects which may be seamlessly integrated into an existing curriculum.

Each winning team's presentation will consist of three parts: (1)students will present their winning project; (2)teachers will discuss the related content and curriculum; and (3)time for questions and answers. The resulting session will create an opportunity for sharing effective techniques and uses of multimedia in the classroom.

Funding for the contest will be provided by corporate sponsors, including: SAS Institute, Roger Wagner Publishing, and Macromedia. These supportive organizations join HyperSIG in providing this unique opportunity for teachers and students to learn from each other how multimedia can be integrated into the curriculum in a variety of global settings. Corporate sponsors will provide travel expenses for the winning teams.

Note: Abbreviated Web versions of winning projects may be found in MidLink Magazine at http://longwood.cs.ucf.edu/~MidLink/.

General Session: Technology Implementation

Finding the "Pressure Points" for Technology Integration in Our Schools

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Key Words: **professional development, community involvement, administrative leadership, technology integration**

The success of the Hanau Model Schools Partnership technology initiative and its expansion to 13 additional schools in the Hessen School District, has meant finding the pressure points that are critical to the infusion of technology in our schools. We have identified four critical points that must be nurtured if schools are to be successful with technology infusion:

- Professional development and ongoing support for teachers to explore connections between technology and the district curriculum and standards
- School-home partnership and involvement of parents and community in decision-making, training and classroom support
- A site-based management team of teachers, administrators, and parents to coordinate training and resources.
- Administrative leadership from principals and the superintendent, in demonstrative ways

Society Session: Staff Development

In-FUSE-ing Technology into Middle-Level Classrooms

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Key Words: **staff development, training, middle school, technology integration**

Fulton Using Stations Effectively (FUSE) is a staff development process that is used in a middle-level school to demonstrate technology integration and classroom management. This year-long series of staff development sessions was designed by a group of teachers who were incorporating technology stations in their classrooms. Their successes generated considerable interest from their colleagues. As a result, the teachers designed staff development sessions using the station approach.

There are two unique aspects of the program: (1) teachers are serving as coaches for their peers and (2) peer coaches and participating teachers observe each other as the strategies are used in the classroom.

Topics covered will include a brief history of experiences prior to the series of sessions, the rationale for the program, the planning and organization of each session, and the overall results of its success. Participants will learn ways to implement a similar program, as well as how to successfully use technology stations in their classrooms.

The presenters were trained in a similar program last year. With their practice and experience in their own classrooms, as well as the development of a training program for their colleagues, the teachers are knowledgeable about integrating technology across several curricular areas.

At Risk: Traditional Teaching! Bring in the Learners and the World Wide Web

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Key Words: **Web, Internet, student projects, design projects, project-based learning**

The presenters will first give a brief background on design projects, project-based learning, and Web-based projects, making some distinctions among the different types of projects and referring the audience to several resources for becoming more familiar with each type.

A substantial amount of time will be allowed for the description and demonstration of Web-based projects by high school and junior high students, and the experiences of their teachers in making these new projects happen. We will first take an in-depth look at one person's experiences in trying to do this as a new teacher (though not new to technology). Allen Sylvester will present his rationale, plans, preparation for, difficulties, and successes in his City of the Future energy projects accomplished by his three science classes, all of which had a high number of at-risk students. He will then discuss and demonstrate his second round of projects, pointing out what he did differently. Pearl Chen will share the findings of her research on the learning of these students.

Next is a broader examination of the experiences of more seasoned teachers who had less technology experience. Also, we will discuss our suggestions and recommendations, drawn from analysis of teacher journals, interviews, and other observations. Issues to be discussed include: feeling competent, classroom control, coverage, assessment, content vs. "wasting time" with technology, time-time-time, resentment from other teachers, and school supportiveness. Diane McGrath will demonstrate the work of seven high school and junior high school teachers and the work of their seven classrooms, covering subjects matters of English, history, German, technology, and science. She will summarize the learning experiences these teachers went through the summer before, and look at their plans, problems, successes, and challenges as they taught their students to carry out this kind of project.

Finally, we will involve the audience in a discussion of issues concerning both the teachers and the students, particularly focusing on these questions:

- Teachers—What kind of experience and support are required to move a teacher from being a beginner at project-based learning and Web-based technology to becoming a successful and confident guide for high school students as they learn to do design projects?
- Students—How long does it take to learn the technology? to learn to take responsibility? to buy into project-based learning? Do students trust the teacher's new grading system? importance of audience.

General Session: Curriculum and Instructional Strategies

Teaching Literacy with Internet Projects

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Key Words: **current research, practices, writing across the curriculum, Internet projects**

We will demonstrate how Internet projects and technology applications contribute to promoting literacy acquisition, math understanding, technological awareness, communication skills, and global awareness. Educators will be able to return to their districts with research and ideas for using the Internet for teaching Grades K–12.

We use meaningful reading and writing across the curriculum with technology applications, Internet projects and e-mail to bring students to literacy, enhance problem solving ability, expand technological research/communication, and facilitate language acquisition for second language students. In addition, our students expand their conceptual understanding of the world in which they live. Included in the presentation will be:

1. Research and theory for the use of meaningful writing to promote higher levels of thinking and how this research ties with Internet projects and e-mail communication. Also included will be research on assessment of language arts and how to create rubrics for Internet projects.

2. Samples of Internet projects and e-mail activities. These projects are from Scholastic Network, Globe Project, and Global School House. We will show teachers how to access beginning projects and guide them through the teaching process. We will also include ideas for Internet projects that teachers can initiate on their own and take back to schools for future use.
3. Demonstration of teaching techniques and time management for using the Internet as a tool to enhance literacy and problem solving through communication and Internet Projects. We will also show how this can be integrated into the curriculum and accomplished with only one Internet connection.
4. We will include examples of student work at each step of the project and examples of student work at the completion of the project, so that teachers can see the complete writing process. The examples of students' writing are in language arts, mathematics, science, and social studies. Although many of the project samples are from primary grades, the projects used have been intended for use at all grade levels.
5. We will include a guide to Internet project sites. In addition, time for sharing and questions will be allotted.

General Session: Distance Learning

Meta-Communication Facilitates Knowledge Building in Distance Education

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Key Words: **knowledge building, meta-communication, distance learning, Knowledge Forum!, CSILE, Web**

As computer network-based distance education moves beyond the transmission and discussion model, toward one based on knowledge building principles, the requirements for rich and differentiated types of communication become evident.

Knowledge building principles, as developed in the Computer Supported Intentional Learning Environments (CSILE) research of Scardamalia, et al., provide an environment in which learning progresses through sustained, in-depth inquiry. The focus is on problems rather than tasks, and inquiry is driven by student-formulated questions which arise from their study together. Students and teacher focus on explaining phenomena and discoveries. They work toward collective goals of understanding, in self-directed small groups, where discourse is taken seriously. The teacher is not the source of all knowledge, but rather models the behavior of a more expert learner.

Thus "knowledge building" is learning that is an intentional and collaborative activity that mimics the way in which knowledge is developed in communities of expert learners. It is characterized by a progressive construction and refinement of explicit expressions of current understanding. The refinement of understanding is a group activity and responsibility, and ideas are openly expressed, elaborated, critiqued, modified, and refined by all. There is an explicit, intentional focus on the problem that is to be understood.

This suggests that different types of communication are important and should be differentiated. The explicit understanding that is being developed is the substantive communication, the knowledge object that is being worked upon. But several other types of communication are necessary and should be kept distinct from the substance. For instance, these include structural, organizational, and motivational messages, progress feedback, attention directing, annotation, reminders, alerts, deadlines, expectations, historical process overview, and scaffolds, to name a few.

Knowledge Forum! is a networked learning environment based on knowledge building principles. It is typically used in a face-to-face classroom, on a local area network. In such an environment, teacher and students come together frequently, and much of the meta-communication and negotiation takes place outside of the computer environment. Knowledge Forum! thus serves as the learning environment for the substance of the learning. It provides some of the meta-communication, including scaffolds for expression of understanding, and organization of the knowledge being constructed into "views" which convey some of the relationships between knowledge elements or "notes." But much of the meta-communication noted above is still carried on outside of Knowledge Forum!.

A Web-based distance learning environment built according to knowledge building principles requires alternate means for the meta-communication normally found in the face-to-face interactions of the classroom. Often in conferencing environments, the meta-communication is mixed in with the substantive discussion, or carried on in a separate discussion thread (e.g., help, cafe, etc.) or by e-mail (e.g., for teacher feedback, discussion between students about task organization). The meta-communication either dilutes the focus of the substantive knowledge building or is removed from it in a way that makes connection between the meta-level discussion and the substantive work quite indirect (e.g., quote[you should look at note 93 and do the following] rather than being able to annotate directly).

We illustrate how some of the knowledge building meta-communication concepts can be accomplished in Web-based distance learning, using the current Web Knowledge

Forum (WebKF) as our example. We suggest ways in which WebKF (and other systems) can be elaborated to provide richer meta-communication capabilities to promote knowledge building. We also have to admit that some of the required functions are difficult to implement in the transaction-based client-server architecture of the Web.

General Session: Curriculum and Instructional Strategies

Burning CD-ROMs to Fire Up Student Learning

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Key Words: **staff development, curriculum integration, CD-ROM**

Seven teacher teams participated in a year-long staff development initiative focused on the development of CD-ROMs as a tool to facilitate project-based learning. Each team consisted of three to five members. Within this staff development initiative, the teams were given the charge of creating an exemplar project that integrated technology into their curriculum. Criteria for the exemplar projects required the teachers to address the following questions in designing the students' work:

1. Is the exemplar project tied to the curriculum objectives in the graded course of study?
2. Does the exemplar focus on student work and students' use of technology rather than the work of adults?
3. Does the exemplar engage students in an inquiry-based learning context where they are using the technology to seek answers and to solve problems?
4. Does the use of the technology result in students being able to access, interpret, create, and/or share information in ways that otherwise would not be possible?

Participating teacher teams met once per month as a group for work sessions. Between large group meetings, staff development took on a more job-embedded focus with the instructor visiting teams and working with them in their buildings to provide technical support and training to the teachers and their students.

This session will outline the specific components of this staff development initiative. Participants will learn how to design and implement the staff development model and have an opportunity to view the CD-ROMs created by the teacher/student teams.

Topics include:

- Project-based learning
- Multimedia
- Components of a CD-ROM
- A staff development model

General Session: Teacher Education and Training

Using Web-Based Electronic Teaching Portfolios with Preservice Teacher Education Students

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Key Words: portfolio, electronic, preservice, teacher education, digital, standards

In this session, I will discuss the creation and use of Web-based Electronic Teaching Portfolios (ETP's) as a form of alternative assessment for preservice teacher education students. An Electronic Teaching Portfolio, sometimes referred to as a digital portfolio, is similar to a traditional portfolio, however, the medium used to present and organize it is different: It is organized using a combination of electronic media such as audio recordings, hypermedia programs, database, spreadsheet, video, and wordprocessing software, as well as CD-ROMs and the World Wide Web.

Preservice teacher education students created ETPs in a one-credit course offered in the spring of 1998 and 1999 at the University of Virginia's Curry School of Education. The goal of the course was to guide students in the creation of portfolios based on the Interstate New Teacher Assessment and Support Consortium's (INTASC) 1992 model standards for teacher licensing (http://www.ccsso.org/intascst.html).

Many schools of education are beginning to incorporate the use of portfolios as performance-based measures. McKinney (1998, p. 85) explains that "[teacher] educators have found that well-constructed portfolios may help to capture the complexities of learning, teaching, and learning to teach when used as authentic assessment tools within courses and programs in Colleges of Education." Also, portfolios can be considered performance-based because they "[allow] the learner to display a variety of evidence of performance, such as products or exhibitions" (Georgi & Crowe, 1998, p. 74). Another characteristic of portfolios is that they encourage preservice teacher education students to be more reflective about what they have learned through their university courses and student teaching. In addition, portfolios serve to document preservice teachers' competence and growth during the course of their entire teacher education program. Georgi and Crowe also suggest that "[portfolio] assessment is thought to be a more 'authentic' way to demonstrate teaching skills and expertise" (p. 74).

Yet, most portfolios that are being used in schools of education today are primarily print-based (compiled in a binder), although they often contain teaching videos as one of the components. Now, with current technologies, it is possible to create Web-based, or Electronic Teaching Portfolios. Should schools of education invest the effort and time in teaching preservice teacher education students to create such portfolios? How can technology, specifically, the World Wide Web facilitate the creation and use of Electronic Teaching Portfolios?

Electronic Teaching Portfolios created using the Web combine the benefits of a standard teaching portfolio with the advantages and challenges of learning to master the use of technology to present them. Tuttle (1997) advocates the use of electronic portfolios because they demonstrate wider dimensions of learning, their parts can be interconnected, and they save space. While creating Electronic Teaching Portfolios can be both a frustrating and rewarding experience, a large benefit to using them is that they demonstrate students' competence in the use of technology, a growing concern for administrators and districts nationwide.

Attendees will learn ways in which they can organize a course on Web-based Electronic Teaching Portfolios as well as learn about the challenges and resources necessary for such a course to be successful. Moreover, some student-created ETP's from the spring of 1998 and 1999 will be shared.

To review the course syllabus, please see http://teach.virginia.edu/curry/class/edlf/589-07/.

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General Session: Technology Implementation

Web Teams

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Key Words: **faculty development, training, team, coach, Web pages, instruction, college**

New Jersey City University wanted faculty members to develop instructional Web pages to enhance their classroom instruction. After considering several models of faculty development, we selected a strategy that focused on teams of faculty members who would work together. Each team was given all the equipment and software it needed, and it was provided with technology coaches. The project has been underway for two years and five successful teams have been organized. The technology coaches have experimented with three training/support formats: (1) providing small group instruction in three-hour blocks every other week, (2) scheduling team meetings infrequently and providing numerous individualized training sessions, and (3) scheduling team meetings as full-day sessions on four consecutive days. The technology coaches have also used templates and more open-ended page composers as training materials. In our experience, the most productive format has been working with teams in full-day sessions that are very structured and then scheduling presentations so that team members demonstrate their work to large groups of colleagues. Making presentations at faculty workshops and at college-wide meetings, creating a Web-team brochure, and specifying completion deadlines were needed to achieve closure.

In this session, attendees will learn about alternative formats for encouraging faculty to develop instructional Web pages and which formats were most productive at NJCU. They will also learn about the reward systems that were used successfully to encourage faculty to complete their projects. This session will also review some of the pitfalls and stumbling blocks that our technology coaches encountered and overcame to make this an ongoing and successful project. Several of the Web pages that were produced by the Web teams will be shown during the session.

General Session: Curriculum and Instructional Strategies

Library Skills: Transforming the Traditional to Interactive Instruction

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Key Words: **bibliographic instruction, library skills, college library, university library**

A one-credit, nongraded college-level library instruction course was restructured from the traditional lecture/demonstration class to a hands-on class where students actively used computers to access information. Because bibliographic instruction textbooks on the college level assume a three-credit course and often feature advanced information, and high school textbooks do not include the diverse databases available at an academic library, it was necessary to create interactive lessons where students could practice locating, evaluating, and using information resources. In addition to creating the lessons, each instructor was provided with a resources binder that included teacher notes, student notes, interactive exercises, and answer sheets.

Topics include:

- Rationale behind the change from a traditional lecture/demonstration class
- Overview of the process to implement an interactive, hands-on environment
- Design of the 14-station classroom

- Development of a course content appropriate for college students
- Presentation of sample lesson plans
- Examination of problems encountered with online, interactive class
- Assessment of overall strengths and weaknesses of the new format

Research Paper: Curriculum and Instructional Strategies

Parent-Completed Screening Test for Developmentally At-Risk Young Children

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Key Words: **screening, test, parents, computer, at-risk children, development**

Abstract

A computer-based questionnaire was developed to help parents who have not received specialized training to determine whether their young children need further assessment for diagnosis of developmentally at-risk status.

The computer will automatically determine a starting point for a series of questions according to the child's chronological age. The computer will also set the basal point according to the child's functional level. When the child reaches a certain ceiling point, the computer will stop asking questions and will calculate the total numbers of "yes" and "no" answers given by the respondent and will present a graphical representation of the child's development. The questionnaire items are written in simple language and use pictures where possible.

The validity of the questionnaire was examined to see how precisely the parent-completed computer-based questionnaire assesses children's development as compared to the Child Development Inventory, a standardized assessment tool. Correlations among the five domains of the computer-based questionnaire and the corresponding domains of the Child Developmental Inventory were significant and strong (from $r = .61$ to $r = .86$, $p < .001$). The sensitivity of the computer-based questionnaire, as indicated by the percentage of developmentally at-risk children correctly identified according to the Child Developmental Inventory, was 80%. The specificity of the computer-based questionnaire, as indicated by the percentage of children without problems correctly identified according to the Child Developmental Inventory, was 100%. The computer-based questionnaire had brief administration

time with a mean of 8.8 minutes. These results suggest that the parent-completed, computer-based questionnaire is a valid tool in screening 15-month- to 36-month-old children's development.

For many years, professionals have assessed children with disabilities and determined goals for them based solely on their own observations (Garshelis & McConnell, 1993). Parents have a rich history of observations and experiences with their children, and information obtained from parents represents a highly desirable source of input that can contribute unique and essential information to the assessment process (Henderson & Meisels, 1994). However, the utilization of parental information in assessment of young children has generally been overlooked. A major reason that parents have been excluded from assessment is the belief that assessments must be administered in a typical fashion and only by a person having required training. Even when assessment tools are based on naturalistic observation, parental involvement has been limited because of the belief that observational skills are also obtained with extensive training (Sheenhan, 1988). Compliance with P.L. 99-457, with such a large population, is difficult for at least two reasons: 1) a limited number of professionals; and 2) financial cost of screening. Utilizing parents to screen their children's development seems reasonable from an economic perspective and has parents as partners at the starting point of the intervention journey. However, these two advantages are of little use unless parents can reliably assess the child's performance.

In order to help parents conduct assessment procedures in a standard way, computer technology can be employed, especially for the assessment of exceptional children (Greenwood & Rieth, 1994; Pea, 1987). Several advantages can be assumed when using the computer in assessment measurement. The computer can: (a) reduce the total assessment administration time; (b) give immediate feedback to responses; (c) reduce recording and computing errors, and increase scoring reliability; (d) improve responder's motivation; and (e) provide a standard procedure of the test administration that can help to get information from parents reliably.

Though recent advances in technology make it possible to improve the assessment procedure, only a few studies have examined the implication of computer-based assessment in special education. Further research is in order to examine whether parents can successfully complete computer-based screening questionnaires on their children. The validity and utility of a parent-completed, computer-based screening questionnaire is examined in this study.

Method

The participants for this study were 46 mothers who have children aged 15 months to 36 months. Because this research investigated the effectiveness of a screening tool, participants were not excluded from the study on the basis of their child's developmental level. Therefore, both developmentally at-risk children's mothers and normal children's mothers participated in this research. Participants were recruited from four child care centers and three community facilities: a church, a university campus, and a park. Demographic information collected from the 46 mothers at the time of the Computer-Based Developmental Questionnaire completion is presented in Table 1.

Table 1. Demographic Information of the Participants

Demographic Variable	Frequency	(%)
Child Gender		
Male	31	(67.4)
Female	15	(32.6)
Level of Maternal Education		
Less than 12 years	3	(6.5)
12 years	5	(10.9)
13 to 15 years	18	(39.1)
16 or more years	18	(39.1)
Not answered	2	(4.3)
Annual Family Income		
Less than $10,000	14	(30.4)
$10,001 to $20,000	5	(10.9)
$20,001 to $50,000	13	(28.3)
Over $50,000	12	(26.1)
Not answered	2	(4.3)

Participants rated their children with the Computer-Based Developmental Questionnaire (CBQ) and the Child Development Inventory (CDI; Ireton, 1992). The CDI is a standardized instrument used to measure the development of children 15 months to 6 years of age. It has a 270-item inventory that describes eight developmental scales of young children in the areas of social, self-help, gross motor, fine motor, expressive language, language comprehension, letters, and numbers. The CBQ is designed for screening 9-month- to 36-month-old children to identify whether they need further developmental assessment. The questionnaire screened in five areas: adaptive-psychosocial, cognitive, speech-language, fine motor, and gross motor. To determine the items asked in the CBQ, the researcher reviewed child development literature and standardized developmental screening scales (Frankenburg, Fandal, & Thornton, 1987; Ireton & Thwing, 1974; Knobloch, Stevens, & Malone, 1980; Lowrey, 1986; Princeton Center for Infancy and Early Childhood, 1977). From this body of literature, the researcher identified a total of 190 items that could be answered "yes" or "no" by parents. Authorware, an application software, and a Power Macintosh 7100/80 computer were used to transform questions taken from literature into the electronic questionnaire.

The 46 participants were randomly divided into two subgroups by the order of test completion. The mothers completed both the CBQ and the CDI. One subgroup took the CBQ first and the CDI later; the other subgroup took the CDI first and the CBQ later. The groups were divided in this way to control any possible effects of the participants' prior completion of one test on the other test. When completing the CBQ, participants answered questions in five developmental domains. Each response was made by indicating either "yes" or "no." Ceiling points in each of the five areas were set based on the answers given by the respondent. A ceiling point in a domain was a question answered with "yes" followed by two questions answered with "no."

This "yes" question had a point-value associated with it, which determined the raw score for that particular developmental area. Each child thus had raw scores in the five domains as well as one average score that was a general developmental score. The general developmental score and the five domain scores from the CBQ, in turn, were correlated with corresponding scores from the CDI. The data analysis was calculated using computational procedures of SPSS 6.0 (SPSS, Inc., 1993).

Results

Validity of the CBQ

A correlation coefficient is one way to see the degree of relationship between a screening measure and a standardized test to verify concurrent validity. Pearson product moment correlation coefficients were calculated between the two tests. In order to control for the effects of child's age on the various scores of the CBQ and the CDI, partial correlation analysis was used. The partial correlation coefficient provides a measure of linear association between two variables while adjusting for the linear effects of one or more additional variables (Norusis & SPSS, Inc., 1993). Table 2 contains the correlation coefficients between the major CBQ component scores and the CDI scores after the effects of child's age are removed. As can be seen in Table 2, the correlations between the CBQ and the CDI are quite high and significant. The general development score of the CDI that is considered to be most related to learning in school significantly correlates with all the subscales of the CBQ (from $r = .59$ to $r = .85$, $p < .001$). A high correlation was found ($r = .83$) on the general development scores of the two tests. The correlations among five domains of the CBQ and the corresponding components of the CDI are presented in bold in Table 2 (from $r = .61$ to $.86$, $p < .001$). Those five correlation coefficients show that those are more strongly correlated with corresponding domains than with any other domains. Cognitive domain of the CBQ does not have an exactly corresponding domain in the CDI, however it is strongly correlated with the general development and the social domain of the CDI ($r = .61$ and $r = .68$ respectively). Overall, the correlations between the CBQ and the CDI offer strong support for the concurrent validity of the CBQ. These strong correlations between the two measures suggest that they may be measuring the same constructs.

Table 2. Correlations between the CBQ and the CDI

Test Domains	**BAD**	**BCO**	**BSL**	**BFM**	**BGM**	**BGD**	**BDQ**
CBQ							
Adaptive (BAD)							
Cognitive (BCO)	.64***						
Speech-Language (BSL)	.78***	.63***					
Fine Motor (BFM)	.56***	.50***	.63***				
Gross Motor (BGM)	.65***	.50***	.59***	.49**			
General Development (BGD)+	.89***	.78***	.93***	.74***	.78***		
Developmental Quotient (BDQ)+	.88***	.78***	.83***	.77***	.79***	.98***	

(table continues)

Table 2. (continued)

Test Domains	BAD	BCO	BSL	BFM	BGM	BGD	BDQ
CDI							
Social	**.84*****	.68***	.75***	.61***	.65***	.83***	.86***
Self Help	.76***	.58***	.54***	.56***	.64***	.76***	.74***
Gross Motor	.67***	.51***	.62***	.47**	**.78*****	.74***	.73***
Fine Motor	.57***	.44**	.60***	**.62*****	.49**	.65***	.66***
Expressive Language	.76***	.50***	**.86*****	.56***	.42**	.70***	.78***
Language Comprehensive	.74***	.54***	.81***	.54***	.51***	.72***	.78***
General Development +	.85***	**.61*****	.83***	.59***	.66***	.83***	.87***

Note: Correlation coefficients are Pearson product-moment *r*s controlled for child's age.
Convergent validity coefficients are presented in bold.
+ These components are not independent domain because they are calculated from the other domains.
**p <.01, two-tailed test
***p <.001, two-tailed test

Validity of the CBQ was also examined by comparing the classification of the children by the CBQ and the CDI. Each child was screened for being normal or developmentally at-risk with both the CBQ and the CDI. The percentages of agreement between the two tests were then calculated. No universally accepted definition of developmental delay exists. However, definitions usually require that the child exhibit a 20 to 30% delay in functioning when compared to his or her peers (Bayley, 1993; Eisert, Spector, Shankaran, Faigenbaum, & Szego, 1980; Ireton, 1992). In this study, a child's development on the CBQ and the CDI was classified as developmentally at-risk if the child's scores fell below the 30% below age cutoff on any domain. The 30% below age cutoff of the CDI was reported as equivalent to two standard deviations below the mean (Ireton).

The results of the CBQ classified 34 children as normal and 12 children as at-risk (Table 3). Meanwhile, 31 children were classified as normal and 15 children were classified as at-risk on the CDI when the 30% below cutoff was applied. The sensitivity of a testing instrument is the percentage of developmentally at-risk children correctly identified according to a standardized test. Twelve of the 15 who were identified as at-risk by the CDI were also identified as at-risk by the CBQ, so that the CBQ's classifications were 80% (12/15 x 100) sensitive in the identification of at-risk children. The specificity of a testing instrument is the percentage of children without problems correctly identified. All 31 children who were classified as normal by the CDI were also identified as normal on the CBQ. All classifications of children as normal by the CBQ agreed with classifications of children by the CDI. Therefore, the CBQ was 100% (31/31 x 100) specific in identifying children with normal development. In summary, the classification of children's development as normal or at-risk by the CBQ agreed highly with the classifications of children by the standardized test (CDI) which verifies the validity of the CBQ. Overscreening and underscreening are two potential errors that can occur during any kind of screening. Overscreening refers to the percentage of children labeled as at-risk by the screening test who are found to be normal by the criterion measure. Underscreening refers to the percentage of children not detected by the screening test who are found to be at-risk on the criterion test (Wolery, 1989). All 12 children who were classified as at-risk on the CBQ were also identified as at-risk on the CDI. No overscreening case was found on the CBQ. However, there were three children who were classified as normal on the CBQ who were found to be at-risk on the CDI. The CBQ's underscreening was 20% (3/15 x 100).

Table 3. Agreement between the two tests

		CDI	
		Normal	At-Risk
CBQ	Normal	31	3
	At-Risk	0	12

Sensitivity: 12/15 x 100 = 80%
Specificity: 31/31 x 100 = 100%
Overscreening 0/31 x 100 = 0%
Underscreening 3/15 x 100 = 20%

Utility of the CBQ

The numbers of questions mothers answered varied from mother to mother because the computer automatically determines a starting point for a series of questions according to the child's chronological age and an ending point to the level of a child's development. The number of questions answered by mothers ranged from 26 to 90 items, with a mean of 47 items (*SD* = 12.70). Time for completion of the CBQ by the mothers was measured by the computer. It included participants' answering the demographic pages, answering the questionnaire, calculating developmental scores, presenting developmental scores on a profile, and saving the data in a file to the computer. Completion time ranged from 5 minutes to 16 minutes with a mean of 8.8 minutes (*SD* = 2.77) and a mode of 7 minutes. The CDI required that parents answer 270 questions. It takes about 30 minutes for the parent to complete the test and 5 minutes to score the results. In contrast, on the CBQ, parents answered about 50 questions and it took about 9 minutes to complete and to score.

Discussion

Correlation Data, Sensitivity, and Specificity of the CBQ

In earlier studies, significant positive correlations were found between parental assessment of children and a professionally administered standardized assessment (Gradel, Thompson, & Sheehan, 1981; Sexton, Hall, & Thomas, 1984). For example, Sonnander (1987) reported results for a parent-completed screening of 18-month-old children in which a high correlation was found (r = .87) between standardized test scores and parental assessment scores. Correlations between the five domains of the

CBQ and the corresponding domains of the CDI ranged from .61 to .87. The high correlations suggest that the CBQ and the CDI are relatively consistent in their ratings of the children's development. Glascoe and Byrne (1993) studied the validity of three developmental screening tests. Those tests were the Denver-II (Frankenburg, Dodds, Archer, Bresnick, Maschka, Edelman, & Shapiro, 1990), the Battelle Developmental Inventory Screening Test (BDI; Newborg, Stock, Wnek, Guidabaldi, & Svinicki, 1984), and the Academic Scale of the Developmental Profile-II (DP-II; Alpern, Boll, & Shearer, 1986). Glascoe and Byrne suggested that a sensitivity of at least 80% was preferred and a specificity of at least 90% was preferred. The sensitivity of Denver-II was adequate (83%), but the specificity of Denver-II was low (46%). In other words, the Denver-II is good at detecting children with difficulties, but it produces a high overreferral rate. This overreferral results in needless parental anxiety and expense, and wastes limited diagnostic resources. DP-II showed adequate specificity (86%), but the sensitivity of the scale was found to be very low (22%). The BDI was more accurate than the other screening tests. The sensitivity and specificity of the BDI were both 72%. Bricker and Squires (1989a, 1989b) examined the validity of a parent-completed screening system called the Infant Monitoring Questionnaires (IMQ). The specificity of the questionnaires was high (over 90%), but the sensitivity was low (63%). This study found that sensitivity of the CBQ was 80% and specificity was 100%. These results suggest that the CBQ is very sensitive to identify developmentally at-risk children correctly and very specific to exclude those children who are normal. However, there is some evidence that the CBQ underscreens children who need further assessments (underscreening = 20%, Table 3).

Completion Time and Cost of the CBQ

Numerous instruments exist which can be more or less useful in screening developmentally at-risk children. However, the majority of the current screening measures are lengthy and have time consuming procedures to interpret the results (Glascoe & Byrne, 1993; Glascoe, Martin, & Humphrey, 1990). Screening measures usually take 20 to 30 minutes to administer and 5 to 10 minutes to score and to interpret. The Denver-II, which is administered by professionals, is reported to take 20 minutes to complete, plus the time involved in scoring the results (Kenny, Hebel, Seston, & Fox, 1987). The BDI screening test takes 10 to 15 minutes to administer for children under 3; for children between 3 and 5, it takes 20 to 30 minutes (Newborg, Stock, Wnek, Guidabaldi, & Svinicki, 1988). The Developmental Profile II usually requires approximately 20 to 40 minutes to administer and score (Alpern, Boll, & Shearer, 1986). The CDI used in this study as a criterion measure usually takes 30 minutes of parents' time to complete and 5 minutes to score. In contrast, the CBQ took about 7 to 10 minutes (mean = 8.8, *SD* = 2.8) by the mothers who did not have a specialized training. The time included completion of demographic screens, completion of questionnaire, scoring, and recording. Because demographic screens were made only for use in this study, without these pages, a reduced time will be expected for a general use of the CBQ. The number of questions answered varied by mothers. It ranged from 26 to 90 items with a mean of 47 items (*SD* = 12.70). These results occurred because mothers were given different numbers of questions according to their children's age and development. This computer system omits unnecessary questions beyond the level of the child's development.

Cost clearly plays a role in the adoption of computer-based assessment. Although development and capital cost may be higher for technology-based assessment, it may yield substantial savings because development costs are one time expenses (Garland, 1995). The cost of implementing CDI for 46 children was about $90 including a manual, questionnaires, answering sheet, and scoring sheet. The cost of implementing the CDI will be multiplied by the numbers of children. This is a case of a parent-administered test so it is relatively inexpensive. However, if a professional needed to administer a screening measure, that system would be more costly. The CBQ eliminated professional time and paperwork, so once it is developed, there is no further cost.

Because of the small sample size, this study could not investigate relationships among child development, parents' ethnic background, and parents' socioeconomic status. In addition, as the CBQ was written in English so the use of the CBQ with groups whose primary language is not English would not be appropriate.

Implications for Future Research

The correlations among the children's various developmental scores on the CBQ and the CDI were significant and strong. The percentages of agreement between the two tests in identifying children as normal or as developmentally at-risk were also high. However, it should be noted that the CBQ is not a diagnostic test. It is only a screening test; therefore, further full scale assessment is needed to confirm the developmental condition of the child. It is important to recognize that a single screening measure of a child with substantial risk factors cannot be used either to confirm or rule out developmental delay (Katz, 1989). A low scoring child is only at-risk, and maybe only temporarily so (Sonnander, 1987). Therefore, the predictive validity, the extent to which the screening test agrees with children's performance on outcome measures later in time, should be investigated. The specificity of the CBQ was 100%, but some underscreening of the CBQ (sensitivity = 80%; underscreening = 20%) was found. Because establishing criterion-related validity is an ongoing process (Allen & Yen, 1979), further studies are necessary to study the validity of the CBQ with other standardized measures.

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A Conversation on Future Visions of Educational Technology: Parts I and II

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Key Words: **conversation, children's software, educational technology, software industry, technology access, technology leaders**

Part I

Join conversations with software visionaries and educational technology leaders such as Warren Buckleitner, Monica Bradshire, Fred D'Ignazio, John Richards, Judy Salpeter, Yoel Givol, and more.

Part II

Continue the conversation and build a vision with software visionaries and educational technology leaders such as Susan McLester, JoAnne Miller, David Dwyer, Allen Cypher, and more.

A Shared Vision

The 21st century is around the corner and now that many NECC participants have been involved in technology and education for more than 20 years it is time to gather, reflect, share our ideas, and work together to develop a renewed creative vision of the future. This vision would bring together the various pieces that we have focused on in the past. These include using technology as productivity tools, for communication, for resources on the Internet, for project-based learning, and as tools for visualizing, synthesizing, and representing information and ideas in new ways. The vision must also include a strong focus on getting quality technology use to students in underserved schools in the lowest economic areas of our country and for disseminating the finest examples of technology use in education.

Bringing Hallway Conversations to a NECC Session

For the past several years, Henry Olds and Margo Nanny have hosted sessions, presentations, and panels with some of the most innovative designers and developers of educational software. While the examples of great software are many, the actual use of technology in many educational settings has left much to be desired. In the past two years, the software industry has gone through massive consolidations and we see less and less development of new, powerful ideas and more repackaging of old ideas with new media. Hallway conversations at NECC and other conferences indicate a great concern on the part of researchers, designers, developers, and educational technology experts that education is becoming primarily a market in which large companies sell hardware, software, educational materials, and services without taking into account the lessons learned or the research that has been done to help drive education in the most powerful directions.

There is also concern that companies trying to make a profit in the educational market do not have the resources to contribute to the necessary research required to help ideas evolve into their more powerful forms.

As a result of these conversations and concerns, this year Margo and Henry will bring together a group of educational software industry greats and educational technology leaders for a conversation on the state of educational technology. The conversation will take place in two back-to-back sessions. The format of the sessions will be large- and small-group conversations. The first hour of the conversation will focus on what we've learned and how we see the goals for the future. The second hour will focus on the work that needs to be done to influence mainstream educational technology ideas and to move the educational technology industry in directions that will benefit our many goals.

Participants will walk away with renewed inspiration knowing that their work can be part of a larger effort in the educational technology community. By creating synergy between our many efforts we hope to create more of a shared vision and use that vision to influence funding sources regarding directions in research and development that need special attention in the coming years.

The Participants

Many friends and associates have requested to participate in these sessions. Among them are the those listed below (alphabetical by first name):

Bernajean Porter: Educational Technology Planners, Inc.

Carol Edwards: Director of Programs, The National Foundation for the Improvement of Education

David Dwyer: President and CEO, OntrackLearning, Inc.

Donna Stanger: General Manager, Edmark Corporation

Fred D'Ignazio: Director, Multimedia Classrooms

Henry Olds: Product Development Specialist, Logal Software, Inc.

Holly Brady: Director, Stanford Institute for Educational Leadership through Technology

JoAnne Miller: Director of External Relations, New Technology High School, Napa

John Cradler: Educational Support Systems, and Director, TECHCORPS, California

John Richards: Senior Vice President and General Manager, Turner Learning

Judy Salpeter: Editor in Chief, Technology & Learning Magazine

Margo Nanny: Education Technology Specialist, Interactive Learning Design

Marilyn Quinsaat: VP Education Information Systems, Computer Curriculum Corporation

Midian Kurland: Chief Technology Officer, OntrackLearning, Inc.

Monica Bradshire: Education Technology Consultant, Formerly of National Geographic Kids Network

Robert Mohl: Educational Design Consultant, Floating Point Media

Roy Pea: Director, Center for Technology in Learning (CTL) and Director, NSF Center for Innovative Learning Technologies (CILT)

Ruthmary Cradler: Educational Support Systems

Sara Armstrong: Director of Content, George Lucas Education Foundation

Saul Rockman: President, Rockman Et. Al.

Stephen Marcus: University of California, Santa Barbara. Coordinator, National Writing Project Technology Network.

Susan McLester: Executive Editor, Technology & Learning Magazine

Warren Buckleitner: Publisher, Children's Software Revue

Yoel Givol: President & CEO, Logal Software, Inc.

Yolanda Jenkins: Director of Learning Systems and Technologies Dept., BBN Technologies

Video Streaming Internet Courses

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Key Words: video streaming, distance learning, Internet courses, distance education, teacher education, Internet

Video streaming on the Internet is a relatively new technology. It is basically broadcasting video over the Internet in real time. The advantage of using this medium for distance classes over the Internet, is that it helps to take Internet courseware out of the realm of being courses of just correspondence. It gives the student at the remote site a sense of being in a real class with the advantage of being able to access the class at any time of the day. Another advantage for the student is the ability of the video stream to be paused and restarted for reflection and note taking. It also lends itself to being revisited, if there is a need. Video streaming helps to bring Internet courseware to a higher academic level and gives educators another tool to fulfill the needs of the learner.

This presentation will demonstrate how video streaming can be used as the primary delivery method for an Internet course. It will cover the basic hardware and software required, problems with the technology, and the use of presentation software to enhance the video. The presenter will demonstrate the graduate course EDUC 7010, Foundations in Education. EDUC 7010 at Georgia Southwestern State University was the first Internet course to use video streaming in the University of Georgia system. Other topics covered in the session will be course design, Web design, Web course tools, and Web support for non distance applications.

Attendees of this session will get a good description of how to set up an Internet course that uses video streaming as the primary means of delivery. They will understand the hardware and software needed for video streaming. The audience will also understand the limitations of the technology and in what direction the technology is headed.

Topics include:

- Instructional design of Internet courseware
- Types of video streaming
- Software requirements of a video streamed Internet course
- Hardware requirements of video streaming

- Bandwidth issues of Internet courses using video streaming
- E-mail, chat rooms, bulletin boards, and their roles in an Internet course
- Assessment of learners at a distance

General Session: Technology Implementation

Digital School Portfolios: Demonstrating a School's Vision

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Key Words: **school portfolios, accountability, reform, World Wide Web, learning community**

Schools are complex places. Each school has its own culture; the faculty, administration, students, and parents all bring their perspectives on what goes on in the school. When the public at large is suddenly aware of something going on in the school, the people involved in the daily life of the school know that there is more—usually much more—to that story. Explaining the rest of the story, however, can be difficult.

In this era of school reform, it is critical that a school community reflect on its work. Schools are being asked to innovate—and they are also being held to new forms of accountability. The school needs to look carefully at what it is doing, and consider what is most beneficial for its students and its staff. In short, the school needs to be able to tell their stories.

In this session, we will examine a way of telling more of that story. We will demonstrate a sample Digital School Portfolio. This is a Web-based template that allows schools to describe their vision of what the school should be—and the evidence of progress towards that vision.

Specifically, schools build Digital School Portfolio by starting with a set of goals. The Web-based template allows the school to post those goals electronically, and use them to organize the contents of the portfolio. Over the course of a school year, members of the school community contribute to the portfolio by documenting their work toward those goals. For example, one school included in its mission that students should gain "the skills needed to live, work and excel in a global society." In the portfolio, a reader can find demonstrations of the school's work in bringing international studies to the curriculum and in developing a mediation strategy for conflict resolution. At regularly scheduled times, the portfolio needs to be reviewed by the school community to determine its overall progress towards fulfilling its vision.

Participants who attend this session will learn what it takes to build such a portfolio. Although we will describe some of the technological details, we will focus primarily on the leadership, logistics, and cultural dynamics required to put forward a vision—and documentation—of a school's work. We will talk about the various audiences a school might have for its portfolio, ranging from the members of its own community to state departments looking for a new form of accountability.

Primarily, what we want participants to understand is how a school portfolio can be a demonstration of a school's commitment toward becoming a "learning community." Such a place has a vision shared by its participants, and the Digital School Portfolio can be a demonstration of how those participants articulate that vision in their every day work.

The building of a school portfolio can be a mechanism, at first, for learning about what is going on in the school. As participants contribute to the portfolio, other members of the school community learn about what other teachers are doing or what building, state, or district policy makers have in mind when they make some decisions. This communication vehicle can be a way to show the larger community about the many good things a school may be doing, whether it be with a new program to improve academic achievement, working with the faculty to create an atmosphere of trust, or using materials and technologies to enhance the work of students and teachers.

Later, the portfolio can help the school community make determinations about the effectiveness of its programs. The building of a portfolio should be followed by a careful review of the contents of that portfolio; that data can be used by the community to determine the next steps it wants to make.

School portfolios require a new kind of openness. Teachers need to be able to describe, honestly, what is happening in their classrooms, and all members of the community need to learn how to use this kind of information to make better decisions about how to proceed. Even though the resulting Digital School Portfolio can better inform the public, the building of the portfolio should be more than a PR exercise; it should be a way to create and solidify a school's commitment to its shared vision.

General Session: Current and Emerging Technologies

Digital Dialogue—Future Trends in Education

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Key Words: Internet, videoconference, projects, research, digital, multimedia

The educational influence of the Internet is constantly evolving. More and more schools are online—causing the shifting of our classroom walls to encompass our community, nation, and the world. The "Global Schoolhouse" is no longer a phrase but is becoming a reality. Through the Internet, students can explore real-world topics to use in projects, much like using an encyclopedia. They can exchange e-mail, research, projects, and ideas with an "expert," or a peer as they collaborate on subjects of interest. Now they can even talk face-to-face with peers and people from all walks of life as they do their research and/or share project results.

Examples of how videoconferencing can be used in classrooms, from kindergarten through high school, will be demonstrated in this session. One of the highlighted multimedia presentations will show how two Florida teachers brought the Florida Commissioner of Education, Frank Brogan, into their elementary and middle school classroom for a videoconference with their students. What an experience for these students! When Frank Brogan was running for Lt. Governor with the candidate for Governor, Jeb Bush, they followed his campaign with excitement. Since he has been elected, students are enthusiastic as they share events from the capital. Students learned the role of our leaders in government and these studies were used as a springboard to include a visit to the classroom by the representative delegation and a senator. Students became interested in the process involved in the creation of laws. They produced their own multimedia presentations, reflecting issues of current interest. These expressions of future legislation which they felt should be enacted were shared with the area's state representative delegation.

This multimedia session will focus on how to plan, set-up, and implement an exciting and educational videoconference for your students. You will learn the steps to planning the lesson, what equipment you need, what reflector sites are available, and how to make this type of activity happen in your classrooms. Your students and you will feel a part of the 21st century as you share ideas, research, and projects with others. A videoconference worksheet will be provided with directions and steps to plan and design the videoconference.

General Session: Curriculum and Instructional Strategies

Timberlane Tales: Problem-Centered Learning and Technology Integration

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Key Words: **technology, curriculum integration, elementary**

Timber Lane Elementary is a small school nestled in a large metropolitan area. With a high yet stable population of low socioeconomic and minority students, faculty and staff at the school worked for two years to find instructional alternatives that would meet the unique and challenging needs of this population. Their research led them to year-round schooling. After surveying the community and making appropriate arrangements with district personnel, Timber Lane Elementary School began a year-round program in late summer 1998. Part of the program was to implement innovative two-week instructional intersessions during the three-week breaks between formal instructional periods. The faculty contacted a broad range of community resources, seeking volunteers to develop and conduct non-traditional learning modules during these times.

The authors—both university professors—offered to participate. What might instruction for upper elementary students look like if it integrated technology throughout the learning process? How would young students respond to that instruction? Norton and Wiburg (1998) state that the design of instruction that integrates technology lies at the intersection of thoughtful decisions about educational goals, content, activities, and tools. Educational goals include instruction that seeks to promote literacy, problem solving, knowledge, information use, and community. Content includes the events, concepts, and examples that reflect disciplinary knowledge and are defined by professional and state standards. Activities include those that are problem-centered, project-based, authentic, constructivist, and cooperative. Tools such as the Internet, word processors, hypermedia, and simulations are selected to support goals, contents, and activities. Thus, a range of technologies become part of the instructional design. Using this model of technology integration suggested designing problem-centered units for each of the intersessions, as opposed to offering workshops on hypermedia or the Internet.

Three multi-age (fourth, fifth, and sixth grade) problem-centered, technology integrated intersessions were planned and implemented. The first intersession challenged students to join the Timber Lane Detective Agency. Here they refined their detecting skills such as fingerprinting, handwriting analysis, code breaking, and mystery solving, as well as identified and arrested school personnel accused of committing offenses, and created their own mysteries. Throughout this intersession, students used the Internet, videos, word processing and desktop publishing, databases, simulations, and interactive fiction. The second intersession challenged students to turn their classroom into a medieval village. The third intersession challenged students to create a space museum. Like the first intersession, activities and content were interlaced with goals and the selection of appropriate technologies.

This general session: (1) describes the problem-centered instructional, (2) presents sample instructional materials, (3) shares products produced by students, (4) reports on the outcomes of these units, and (5) presents insights and reflections about teaching technology integrated, problem-centered curriculums. Thus, those attending the session will learn about a model for making decisions about technology integration, three examples of the model in action, and reflections on the impact of using the model to design and develop technology integrated curriculum.

Reference

Norton, P., & Wiburg, K. (1998). *Teaching with technology*. Ft. Worth, TX: Harcourt Brace College Publishers.

General Session: Curriculum and Instructional Strategies

Study American History, Study Your History

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Key Words: **curriculum integration, history, genealogy, immigration, language arts**

The study of history to many students is the study of the dead past. These students do not understand and appreciate the struggles of their ancestors. Thus there is no understanding of the dynamics that continue to shape their lives today.

Innovative integrated language arts and social studies curricular units allow students to gain a much greater appreciation of both their own history and American history. These units can combine computer simulation, multimedia, video, research (online and offline), writing, speaking, and reenactment.

The second of three units involves an immigration/genealogy unit to be undertaken in language arts while history class covers exploration and colonization. While the students study American history, they simultaneously study their own history and that of their family—their roots. The intent is to instill in them pride in their American heritage and also in their ancestral, national heritage. Hopefully, they will understand their nation and its composition better and also have a greater appreciation for whom they are.

The students begin with genealogy study which includes first and second generation interviews and investigations into the students' own ancestry. The use of computerized genealogy programs is encouraged. Students later present the results of their research.

A study of the immigration patterns of the mid-19th century also begins. Although all students are not able to research their own history, they can become honorary Irish. Students utilize an updated version of the Harvard E.T.C. Irish Immigrant Adventure. They utilize a multimedia presentation on the Irish immigrants, and write a journal from the perspective of their adopted Irish family. More capable students are encouraged to create a multimedia journal.

For many students, their ancestry research takes them to Ellis Island. The culminating activity of this unit is a reenactment of the Ellis Island experience. Reflective writing is used by the students to evaluate their feelings and insights obtained during the simulation. A multimedia presentation is included in this focus session that includes video clips of several genealogy presentations and the Ellis Island reenactment, and excerpts from their Irish Immigrant Journals and their reflective writings.

Although this unit ends after the reenactment the saga of their Irish immigrant, it will continue in the final unit of the year, the Civil War. The history of the Irish Brigades will be investigated and the possible adventures of their immigrant written about. If their own ancestry can be traced to the American Civil War, it, too, will be included.

Persons attending this session will gain an understanding of how technology can be integrated into the regular curriculum as a powerful learning tool. In addition to a brief overview of the entire program, attendees will be given extensive information on this unit. They will also see the "Irish Immigrant Adventure" simulation, multimedia student presentations, and computerized genealogy research results.

The presenters have collaborated for over five years to develop and refine these units. Merry Reynolds is a language arts teacher, Todd Novakofski is a history teacher and technology specialist, and Judith Lovely is a reading specialist. The units have been utilized, evaluated, and revised repeatedly as a result of the classroom usage by the presenters. This program is described in *Educational Technology: Best Practices from America's Schools, Second Edition*, by William C. Bozeman, copyright 1999.

General Session: Curriculum and Instructional Strategies

Library Adult Literacy and Technology: Volunteers Integrate Technology

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Key Words: training, volunteer tutors, adult literacy, Internet, application tools

Library literacy programs face unique opportunities by integrating technology into adult basic education instruction. As information centers, libraries are committed to providing universal access to books, material, and technology. Library literacy programs are committed to supporting that access for adult new readers. At the Brooklyn Public Library, the Learning Centers provide these services. Key to helping students is the training and development of a cadre of volunteer tutors who donate a minimum of 100 hours to lead a small group of adults.

One hundred and one volunteer tutors facilitate learning for 774 adult students whose skills range from non-reading to pre-GED reading levels. Tutors are introduced to our approaches through an initial tutor training, ongoing experiential workshops, and a Curriculum Guide complete with lesson plans.

During the presentation, participants will learn about:

- How technology is incorporated into initial tutor training workshops using laptops and engaging tutors in technology-based activities.
- A hands-on eight session workshop designed to provide tutors with practical experience with technology in a project-based environment. The sessions include introducing volunteers to a range of application tools, CD-ROM software, scanners, QuickTake cameras, and the Internet. These workshops are

geared toward experienced volunteer tutors with little experience with technology.

- Incentives we created to encourage novice users to plunge in.
- A curriculum guide designed to give tutors enough information to begin incorporating technology into their lessons.
- Lesson plan ideas. Participants will receive copies of lesson plans that work!
- The issues and challenges of maintaining an active learning environment.

The Brooklyn Public Library Literacy Program is a nationally recognized program pioneering the use of technology with adult new readers beyond the universe of drill and practice. We are committed to ensuring that staff, tutors and learners have the support they need to successfully navigate into the 21st century. The BPL program has received numerous grants to continue the development of its technology component, including a three-year grant from the Lila Wallace-Reader's Digest Literacy in Libraries Across America Initiative.

General Session: Distance Learning

Designing Successful Online Programs: From Course to Degree

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Key Words: **distance learning, professional development, science education, Internet**

The National Teachers Enhancement Network, developed at Montana State University—Bozeman, has been successfully delivering online distance learning graduate courses for secondary science teachers for the past six years. Funded by the National Science Foundation, the project goals include increasing teacher access to quality professional development by exploring distance learning delivery methods, establishing graduate credit courses taught by active research scientists, and providing teachers with increased knowledge in scientific content.

More than six years have passed since the pilot science courses for the National Teachers Enhancement Network (NTEN) first appeared online. Starting with the adaptation of two existing teacher-enhancement courses (Water Quality and the Physics of Energy), NTEN has since developed and delivered approximately 40 graduate courses, taught by faculty and researchers in fields ranging from physics to mathematics education, and served more than 1,100 inservice teachers from around the country—and around the world. NTEN courses have proven to be so successful and popular with instructors and participants alike, that MSU recently approved a new degree program—the MS in Science Education—designed for practicing science teachers. This program uses distance delivery for the majority of its courses, which are supported by on-campus summer experiences.

Although much has changed as NTEN has developed (e.g., NTEN recently added an "Electronic Campus," funded in part by NSF, to bring non-credit, teacher enhancement opportunities online), the basic fundamentals have remained unchanged. The goal is still to bring practicing teachers together with university faculty, and to provide high-quality learning with methods that make the science content relevant to the classroom. By continuing to provide the courses electronically, NTEN broadens access and reduces costs to the participants. Moreover, scheduling courses during the school year allows participants to use their classrooms as laboratories—places to examine how to bring their own learning to bear on classroom practice.

The design of the initial NTEN courses was largely by trial and error, since this form of asynchronous delivery was quite new. Experimentation was and continues to be the rule, and NTEN instructors have been encouraged to develop their own course design templates. But instructors have learned from each other, and certain features have become common to many NTEN courses. For example, although access to a course is asynchronous (with participants logging in at different times of the day or night), learning within the class needs to be carefully synchronized, so that online discussions are meaningful and group work can be conducted. Failure in this respect turns the participant experience into a correspondence course, and drop-out rates soar. So courses tend to rely on tight structure and frequent minor deadlines to keep the class together and maintain interactivity.

Our belief, developed over time working with different conferencing platforms, is that there are identifiable principles in NTEN's model of asynchronous computer-mediated learning that are largely technology-independent. Recognizing these can help instructors develop new courses and can help course participants make the most of their learning experiences.

Topics include:

- Successful models for developing, delivering, and technically supporting online courses

- Establishing high-quality professional development for science teachers at a distance
- Access and cost issues in online professional development for teachers
- Faculty development and support for course design and delivery
- Student support services
- Horizon Research, Inc. evaluation results from an asynchronous computer-mediated graduate program
- Online course structure that works

Research Paper: Curriculum and Instructional Strategies

Web-Based Instruction: Business Courses

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Key Words: **Web-based instruction, Internet tools, curriculum development, Web design**

Web-Based Instruction: Design, Implementation, and Application

The Internet provides great potential to improve learning and teaching, as well as provides unlimited resources of information. With the Internet's wealth of reading material and with the discussion on listservs and newsgroups, students have much to critique, analyze, argue, and summarize. E-mail and Web-based discussion forums provide an ideal medium for students to write easily and frequently and to receive immediate feedback on what they have written.

At Bronx Community College/The City University of New York I have designed and developed a department Web page, faculty development and training Web page, and all course materials on the Web, which includes syllabus, interesting links in my content area, and a World Wide Web exploration assignment for several business courses I teach. This paper will focus on the design, implementation, and application of interactive Web-based learning.

How Did I Use the Web?

- Managing the *dissemination* of course materials—Include such items as course topics to be covered, my office hours, textbook information, course objectives, and grading policies.
- Instructor/student *communication*—Provide access to my e-mail link and to discussion groups that I have set-up for student-to-student communication, and create forms that my students can use to report problems or provide biographical information about themselves. Listservs are an excellent way to make class announcements, schedule changes, and due date reminders. Virtual office hours can be created using MOO software.
- Assignments and tests—Distribute assignments and tests, and provide for online completion or submission.
- Material covered in the classroom—Make handouts available either as Web pages or as downloadable files.
- Access to Information resources on the World Wide Web—Provide links to other pages which cover information on the topic, similar courses that may also be available on the Web and other on-campus resources that may help my students complete the course.
- Students' Web publishing

Internet and Web Publishing Projects

Part I. Internet Projects

Introduction. The Internet portion of the course began with an introduction to accessing the Internet. This included e-mail, research using a menu-based program (Gopher), research using search tools, and signing on to a listserv.

Internet Projects. The purpose of these Web assignments are: to encourage students to take an active role in the learning process, and to expose students to the Internet and technology skills they will find necessary in today's work world. By integrating technology into the classroom, students are encouraged to be active participants in the creation of knowledge rather than passive reactors to instruction. Technology and the Web assignments involve students in the learning process and motivates them to take more responsibility for their education. Nearly all course assignments were to be handed in electronically.

Project 1. Web Search

Use both a spider-based (e.g., Lycos) and a list-based (e.g., Yahoo!) search engine to research a topic of interest to you. Which search engine delivered the best (most useful) information? Find one article on the following topics:

- Copyright and privacy

- Data security
- Distance education
- Web-based teaching/learning
- Web-page design

Write a one-page paper outlining what you found.

Project 2. Job Search with the World Wide Web

Surf the Web and find three jobs that might be of interest to you after graduation. You can try any of the following URLs, or use other sites of your choice.

JobWeb	http://www.jobweb.org
NY State Dept. of Labor	http://www.labor.state.ny.us
Yahoo! NY Classifieds	http://classifieds.ny.yahoo.com/ny
Online Career Center	http://www.occ.com
Career Path	http://www.careerpath.com
Federal Jobs	http://www.fedworld.gov/jobs/jobsearch.html
Nationwide Job Network	http://www.nationjob.com
U.S. Dept. of Labor–America's Job Bank	http://www.ajb.dni.us.com
Jobcenter	http://www.jobcenter.com

Project 3. Electronic Mail

It is time to communicate electronically. I want you to use your e-mail regularly (as often as you read your regular mail). Search the Web and find three interesting sites which are related to our course. Send me e-mail and cc to one of your classmates. Before you begin typing, spend some time organizing your thoughts and thinking about what you want to say. After you have typed the memo into the e-mail system, reread it with a critical eye and edit it for clarity. Please keep the message brief, but include your name. In a day or two I will send you a reply.

Project 4. Listservs

Find a listserv list on the Internet that is about a topic which you are interested in. Subscribe to that list. Submit a short report on your experiences.

Project 5. Graphics

5a. Locate a copyright-free graphic that can be used in a Web page you will create.

5b. Use a scanner or QuickCam camera to create images that can be used in a Web page you will create.

Part II. Creating and Publishing a Web Page

Project 1. Research/Proposal (Needs Assessment)

Plan and storyboard your entire page-development process on paper. You are required to write a proposal of what you are going to produce. You are expected to conduct necessary investigation and collection of materials, digitize the information, and produce a report in a multimedia format.

The proposal should include:

- What is the title of your Web page?
- What is the purpose of the Web page?
- Who is your target audience? Develop the Web site by analyzing the audience because they possess different levels of motivation and understanding and different learning styles. In addition, pay attention to the learner's computer literacy which will range from none to extensive.
- Consider resources needed to meet the goals and objectives.

Project 2. Interface Design

Based on the proposal, organize your research using index cards. This is the phase when you determine the graphical user interface and the overall visual look of the project. Completely think through your ideas before using HTML. You are encouraged to revise and edit the index cards. Attention should be paid to design, layout, visual elements, and relevant links.

- Where you are starting from (home page)?
    1. Create a hierarchical map of your site, starting with your home page.
    2. Organize the information into major categories and subcategories. You need to divide the project into smaller components.
    3. Balance is the key to making decisions about the number of levels a site should contain and what information should appear at each level.
    4. Create table of contents
- Where you want to go (information you need to locate)?
    1. Navigation: Decide how buttons and menus will help the viewer navigate their projects.
    2. Decide how the screens will be connected—linking.
    3. Label navigation buttons.

- The roads that may take you there (hotspots/links)
    1. Links to relevant and appropriate resources.
    2. What are the link selection criteria?
- Interactivity: It should be user-friendly, making accommodations for all levels of computer user. It should allow input of information. Some components of interactive pages are forms (student information form), guestbooks, and Javascripts.
- Consistency
    1. Grouping sections of closely related information visually with horizontal lines.
    2. Providing the page's URL, information heading for each page, information about yourself such as your name and e-mail address (source of information), and information about when the page was last updated.
    3. Consistency in the placement of buttons.
    4. Consistency in the color, backgrounds, and style of text.
    5. Develop repeated page elements (e.g., banners, icons).
- Keep it simple
    1. Frames and image maps were avoided since most browsers, other than Netscape 2.0 and higher, and Internet Explorer 3.0 and higher, do not support frames.
    2. Emphasize content over form.
- Coordinated graphics
    1. Keep graphic file sizes small. Keep a graphic image between 35K and 50K. Large graphics can delay a Web page in loading. You can also provide thumbnails for larger images.
    2. Graphics should contribute to the content. Some graphics may detract the reader from the content of the page.
    3. Keep graphics to a minimum because many users have older computer hardware with low speed modems.

Project 3. Project Production (Implementation)

The Web page must contain the following:

- information about yourself such as your name and e-mail address

- information that you have gathered, edited, written, designed, or otherwise created that offers a service to other members of the Internet community, for example, a collection of links related to a hobby of yours, text that offers helpful information, and news
- link to our course home page
- link to an ordered list of three favorite Web sites that are related to business use of Internet
- a background color and design

Plan out the sequence, the text, the sound, the picture, and the snap shot you want to add to each screen. The assignment is due in the form of .html files on a disk. You will be graded on your design of the pages, graphics design, the content and use of HTML. Using Netscape, verify that the world is now able to view your home page.

Project 4. Refinement and Maintenance

At this stage, it is important to consider the hypertext capability of the Web that makes it so flexible and easy to use—both within and outside of your own Web site. You also need to consider adding graphics, sound files, movie files, and other forms of multimedia. For multimedia files, it is a good idea to tell your audience the type and size of the file so that they can decide if they want to view or listen to it. You can also use a small GIF image called a thumbnail, a link to a multimedia element that indicates graphic, sound, movie, or animation.

- Once your site is completed, ask some of your peers, and experts in both the subject matter and Web design to evaluate your page.
- Design pages that are viewable in all major browsers including Netscape and Internet Explorer, under varying conditions. Access your own Web page from different computers, with and without a modem, to see what your audience may be seeing.
- Evaluation is an on-going process, not a one-time task. Check your Web site for errors, find ways to improve it, keep information and links up-to-date, and include new subject matter and technological issues when appropriate.

Project 5. FTP

Establish a Web page on the college server using WS_FTP software.

Project 6. Presentation

You will be using the Instructor's station to show your final project to the class and discuss your creation. Your presentation should be five minutes. Submit your disk and printouts.

Project 7. Web Evaluation

You will hand in a printout of your project on a disk with your project on it. Each presentation will be evaluated by the instructor (50%) and five randomly selected students (each 10%) from the class. The evaluation will be done in the classroom. The following criteria will be used for each presentation.

Evaluation criteria: Please use the scale of 1 to 5, with 5 being the highest level for each category.

Content

1. Is the page informative and substantive?
2. Are the objectives of the program clear?

Creativity

1. Is the information presented in a new and exciting way?
2. Is the information well organized? (Appropriate graphics and visuals? Easy to navigate?)

Navigation

1. Can you tell where the buttons are and what they mean?
2. Do you know where you are in the program and how to return? (Is the navigation clear and easy?)

Overall evaluation including the completion and full functionality of the project.

Conclusion

What was most interesting about Web-based instruction was seeing how using the Internet changes the nature of teaching and learning. Instead of learning being primarily something delivered by the instructor in the classroom, it became something very student-centered. Learning took place through work in small groups, researching; using multiple resources including online research and visiting local computer stores, if necessary; and creating Web pages. After some students' initial hesitation—most had no prior Web exposure—they quickly became accustomed to using the Web as a supplement to the lectures. The Web proved beneficial to those students who missed class. Lectures and one-to-one faculty-student interaction are still important, but technology lets students take a more active role in learning. Students use computers for research, discussion, publishing, and presenting their reports. E-mail office hours increases my own personal contact with students.

Courses use a constructionist approach to learning, giving students a great deal of flexibility in the direction, scope, and purpose of course projects.

Next year, the Web-based course will be offered by the Department as an alternative to traditional print-based distance education. Students with Internet access at any place in the world will be able to receive college credit for the course.

Are Academic Behaviors Fostered in Web-Based Environments?

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Key Words: **intranet, Web-based learning, metacognitive reflection, problem-solving ability**

This study investigated the effects of a shared, intranet science environment on the academic behaviors of problem-solving and metacognitive reflection. A quasi-experimental design randomly assigned biology classes to traditional or shared, intranet learning environments. Pilot-test Web-based distance education software created the simulated intranet learning environment and provided user movement tracking ability, while the visual learning software, Inspiration, was used to generate concept maps and measure learner metacognitive reflection. A modified ecology curriculum provided contextualization and science content for the shared, intranet, and traditional learning environments.

Data analysis suggested movement toward weak support for differences in problem-solving group means. Significant support, at the .001 level, for increases in problem-solving ability resulting from use of a shared, intranet learning environment was seen when individual differences, as measured by paired analysis, were employed. Analysis indicated significant support for improved metacognitive reflection across number of concepts (.04) and number of concept links noted (.04), but not for number of concept nodes. Use of the visual learning tool within the shared, intranet learning environment significantly improved reflective thinking in learners. Analysis of gender differences in problem-solving ability and metacognitive reflection indicated no significant differences. Lack of gender differences in a shared, intranet environment seemed contradictory. However, the cooperative, collaborative nature of an intranet environment revealed itself. Such environments appealed to, and ranked high with, the female gender. Lack of significant gender differences strongly suggested an equalizing effect.

This shared intranet learning environment posed one model which science classrooms can use to create equal opportunity for both genders. Tracking learner movements within a Web-based, science environment has metacognitive as well as problem-solving implications for each and every learner.

Introduction and Rationale

As the intranet (Dede, 1997; Jonassen, 1995, 1996) is introduced into the learning environment (James, 1996; Ryser, Beeler & McKenzie, 1995) comprising the classroom today, the effects of this technology must be investigated (Ryder & Wilson, 1994, 1995, 1997; Schneider, 1994). Technology offers opportunity to affect academic behaviors such as problem-solving ability and metacognitive reflection (Brooks & Brooks, 1993; Driscoll, 1994; Jonassen, 1996; Papert, 1993).

As technology moves to a Web-based environment (Jacobsen & Levin, 1993; Ryder & Wilson, 1994; Soltesz, 1996), research must be conducted to determine the effectiveness of geographically unrestricted, collaborative problem-solving (CSILE, 1996). This type of collaboration (Cox, 1997; Hewitt, 1997; Ravitz, 1995; Ryser, Beeler, & McKenzie, 1995) becomes possible when the learning environment is placed on a networked (Miller, Chaika, & Groppe, 1996; Strommen & Lincoln, 1992) Web of computers, thereby facilitating access by many to the same place on the intranet (BlackBoard, Inc.).

As students use the collaborative capabilities of a networked intranet learning environment (Waugh, Levin, & Smith, 1992), thinking about their own thinking evolves (James, 1996; Jonassen, 1996; Papert, 1993), thereby increasing the opportunity to clarify misconceptions of knowledge, procedural or declarative (Mestre, 1996). The science classroom presents one opportunity to study the effects of a shared, intranet environment on student problem-solving ability and metacognitive reflection skills (Knezek, Southworth, Christensen, Jones, & Moore, 1995; Mestre, 1996; Pea & Gomez, 1992; Sinkpen, 1996; Slough & McGrew-Zoubi, 1996).

The purpose of this study was to investigate the effectiveness of a shared, intranet learning environment on problem-solving ability and reflective metacognition in 9th–10th grade biology students. As gender differences emerged within this shared, intranet environment, they were studied (Miller, et al., 1996).

Because students constitute all classrooms today, the effect of learning environments upon differing cognitive abilities was tested. Students enabled data collection that addressed the effect a shared, intranet learning environment had on the academic behaviors of students, specifically problem-solving ability and metacognitive reflection.

Research Questions

1. Did the use of a shared, intranet environment improve learner problem-solving ability in science?
2. Did the use of a shared, intranet environment increase learner metacognitive reflection as evaluated by Web-based CourseInfo software, tracking capabilities within a threaded discussion site and measured by concept mapping from visual learning software (Inspiration) to determine changes in learner thinking patterns?

3. Did gender differences emerge with the use of a shared, intranet science environment for problem-solving ability and metacognition?

Methodology

Subjects

Subjects for this study were first time 9th and 10th grade biology students from three public education high schools in the Conroe ISD within Conroe, Texas. The sample (n) contained 78 students of the 1,400 students enrolled in Biology I courses. Two classes from each school were selected and randomly assigned as a control class or a treatment class. Selected campuses operated on an A–B, 90-minute class alternating block schedule. Classes operating on this type of schedule met three days per week and two days per week, alternating every other week. The sample population included male and female subjects.

Technology

Groups assigned to treatment groups received access to technology. This technology included Macintosh platform computer labs or classroom computers. All treatment groups had access to at least 6 and at most 10 computers.

Scanners, digital cameras, Internet-connected computers, and laser printers rounded out the technology utilized by the treatment groups. Software accessed included Apple QuickTake photo software, HP scanning software, Microsoft Office 95, Netscape Navigator 3.0, and Inspiration 4.0.

Ecology Curriculum

To limit any physical risk, each teacher at selected campuses received an Adopt-a-Ditch ecology curriculum (SeaGrant, 1996). The researcher provided training for all curriculum lessons, use of LaMotte Freshwater Testing Kits (LaMotte, Inc.), Web-based database (BlackBoard, Inc., 1998), and administration of all pre and posttesting instruments. Intentional intranet discussion forum topics were generated by teachers and the researcher during the training sessions. Spontaneous forum topics were noted as the researcher analyzed collected data.

Teacher Training

Training took place over a 3-day time period, for 2 hours each day. An additional 1.5 hour on-site training session ended the teacher training. All training occurred prior to research initiation. Each teacher received complimentary computer diskettes upon completion of each training session.

Technology training consisted of instruction and practice in the use of the CourseInfo intranet simulation software, Inspiration, uploading and downloading files via the Internet, digital camera use, downloading of images, use of Excel spreadsheet/graphics capabilities, and use of the discussion forum environment within the Web-based environment.

All teacher training sessions involving the LaMotte Freshwater Testing Kit focused on MSDS safety sheets, general safety practices, disposal of used testing solutions, disinfecting procedures following fieldwork, understanding each freshwater test, and practicing testing techniques (Flinn, 1997; LaMotte, Inc.; Levine & Miller, 1989). All teachers received a pail of kitty litter for use during the study. The highest standard of safety was established by each teacher in the study and maintained for all class sessions as necessitated by the curriculum content.

Training involving discussion and overview of the ecology curriculum document was incorporated into each training day. Both treatment and control version curriculum documents were used in the training.

Instruments

Treatment and Control groups were randomly assigned at each campus by the principal investigator. Treatment and control groups at each campus were taught by the same teacher. Several instruments were used to discern problem-solving ability and metacognitive reflection in both groups.

Problem-Solving Ability

The Watson-Glasser Critical Thinking Appraisal was used to measure student's problem-solving ability (Psychological Corp., 1990). The Watson-Glasser was selected due to its ability to measure certain aspects of critical thinking, including the ability to 1) recognize problems, 2) evaluate evidence cited to support claims for truth, 3) reason inferentially, and 4) apply the preceding to problems. The test included norms for high students which were developed systematically for this grade level. The reading level was ninth grade and the mental skills it demanded were probably above that. The test was administered in a group setting and was timed at 40 minutes, which fit the campus classroom schedule of the treatment and control groups. Validity of the test was more than acceptable when assessing instructional programs. Evidence supported several aspects of the construct validity of the Watson-Glasser instrument.

Metacognitive Reflection

In the treatment group, this behavior was measured through use of student-generated concept maps developed through Inspiration (Inspiration Software, Inc., 1994), the visual learning software program. Differences targeted included: 1) the number of concept circles generated, 2) the number of links between concept circles, and 3) the number of concept nodes between pre and post concept maps. Metacognitve reflection was also evaluated by 1) logons to the threaded discussions Web page, 2) number of threaded statements, 3) number of threaded dialogue statements of response to other student statements, and 4) number of threaded dialogue statements of response to teacher statements.

Subjects in the control groups generated pretest as well as posttest flowcharts for reflection on changes in thinking connections and patterns by using hand-drawn maps. These changes targeted: 1) the number of concept circles, 2) the number of links between concept circles, and 3) the number of concept nodes between pre and post concept maps.

Preliminary Findings

In answering the first question, "Did the use of a shared, intranet environment improve learner problem-solving ability in science?" the data did not provide support. While groups did not differ significantly in terms of problem-solving ability, results from t-Test analysis supported movement toward significant differences as a result of exposure to the shared intranet environment. Significant support for increases in problem-solving ability were seen when individual differences, as measured by paired analysis, were employed. Given the individual nature of problem-solving ability, these findings suggested even clearer support for the use of collaborative, constructive, and connected technologies in impacting problem-solving abilities. Use of these technologies within the framework of the science classroom (because of the problem-based opportunities) appeared productive and naturalistic. By providing the contextualization for meaningful inquiry (Brown, et al., 1989; Burbules & Callister, 1996; Cox, 1997; CSILE, 1989; Gokhale, 1995; Jonassen, 1996; Ravitz, 1995; Spiro, et al., 1991; Strommen & Lincoln, 1992; Wilson, 1995), meaning-making thrived and re-application of that meaning to new, problematic situations increased. Problem-solving ability, or critical thinking, moved toward improvement when supported by technologically-created shared, learning environments.

The question of length of exposure within this environment became an important one. Much research supported lengthy time periods of exposure to shared learning environments as methods connected to increased problem-solving ability (CSILE, 1989; Ryser, Beeler, & McKenzie, 1995). Yet, exceptionally small numbers of studies have documented the effect of compacted time periods focused on increasing problem-solving abilities (Abeygunawardena, 1997). A limitation of this study appeared initially as the short time frame allotted to the study. However, the study's allotted time frame represented the reality of many science approaches currently in use. The findings of this study became more relevant given that the design methodology mirrored classroom realities. The significant findings for paired differences can continue to be studied, but should also be taken as one potential method for increasing problem-solving ability through technology. While this study did not address all possible questions of what increased problem-solving ability, it did examine one particular model, that of a shared, intranet science learning environment. Through this examination, favorable results indicated the potential this environment has as one method for improving problem-solving ability. As the length of time was considered with the improvement of problem-solving ability, one continued to ask if something else was at work contributing to this increase in problem-solving ability, over this short duration. This point led to the discussion of the second research question.

Data analysis in addressing the second question indicated significant support for improved metacognitive reflection across number of concepts, number of concept links, but not number of concept nodes. Use of the visual learning tool generating concept maps within the shared, intranet learning environment significantly improved the amount of reflective thinking learners engaged in as indicated by the results. Both group means and paired analyses supported significant changes in metacognitive reflection.

The power of metacognitive reflection has been well-documented (Anderson-Inman & Zietz, 1993; Collins & Brown, 1986; Gordon, 1996; Jonassen, 1996; Polnick, 1997; Sweany, McManus, Williams, & Tothero, 1996). The construction of individual representations allowed learners to monitor and facilitate their own problem-solving (Gordon, 1996). The process of metacognitive reflection appeared to become inextricably connected to problem-solving ability, as others have suggested (Gordon, 1996; Jonassen, 1996; Polnick, 1997). Add to this process the multiplicative power afforded by a shared, intranet learning environment, and the element of time, as linked to improved problem-solving ability, appeared to become compacted. The results of this study robustly supported the use of visual learning software (concept mapping tools) within a shared, intranet learning environment to improve metacognitive reflection and movement toward improved problem-solving ability.

The robust results of improvement of metacognitive reflection within the shared, intranet learning environment and the interwoven connection to problem-solving ability suggested a model for the improvement of problem-solving ability within shorter time frame constraints. Additional research seemed unwarranted, but perhaps worthwhile.

Analysis of gender differences in problem-solving ability and metacognitive reflection indicated no significant differences. Group means and paired analyses for problem-solving ability and metacognitive reflection showed no differences with the shared, technology-supported science setting. At first glance, these findings shaped themselves as contradictory to landmark gender studies (AAUW, 1992; Campbel & Storo, 1994). However, when the shared, intranet environment was scrutinized, a cooperative and collaborative nature revealed itself. Environments of this type seemed to appeal, and rank high, with the feminine gender (Jones, 1991; Martinez, 1992; Miller, et al., 1996). The lack of significant gender differences in problem-solving and metacognitive reflection resulting from the shared, intranet learning environment strongly suggested an equalizing effect (Loyd, 1989). This shared technology-supported learning environment posed one model which science classrooms can use to create equal opportunity in scientific endeavor for both genders. At the very least, the lack of significant differences as a result of the environment presented a potential model of improvement of problem-solving ability and metacognitive reflection which crossed all boundaries of gender.

Future Implications

The results of this study presented one practical model for infusing technology into the classroom setting, for improving problem-solving ability and metacognitive reflection over a short duration, for creating a collaborative, cooperative learning space, and for maintaining a science space for learning where no gender differences arose.

The power an intranet offered within the constraints of a school district, or geographic locale, have yet been tapped. This study proposed one mechanism for doing just that, given the infrastructure present or absent through use of a Web-based intranet. This model offered a "get your feet wet" method of networked connectivity for classrooms and teachers who have not yet jumped into the World Wide Web.

This research provided a study in contextualizing connectivity with end goals of improved problem-solving and metacognitive reflection. Both of these elements were often lost when initial attempts to jump into networked learning have been contemplated. Further, this study provided an avenue of documenting the nature of learning during the use of Web browsing or other networked connections. Tracking learner movements within a browsed Web site has metacognitive as well as problem-solving implications for each and every learner.

General Session: Technology Implementation

Internet Past, Present, and Future: What Do Teachers Really Need to Know?

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http://planetx.bloomu.edu/~rpastore

Key Words: Internet and teaching, Web learning, future technology

More and more teachers are becoming "Internet literate" as the nation's schools gain Internet connectivity. Resources for teachers who want to use the Internet include inservice training programs, workshops, conferences, and courses through colleges and universities. The question which must be answered in each of these learning environments is: What do teachers need to learn about the Internet?

The Internet, like many of the emerging technologies, can be a hindrance or an asset to the learning process. Teachers who learn the "how to's" of the Internet may not necessarily improve their teaching. Teachers must learn to take advantage of the characteristics of the Internet which separate this medium from any other technology used in the schools.

One approach which can help teachers be creative and incorporate meaningful integration of Internet into the classroom is to view the Internet from three time perspectives.

The Internet of the Past

Teachers need to have a historical perspective of the Internet in order to understand the Internet as it exists today. Because teachers are involved in a leadership role in teaching their students, they need to understand how the Internet has evolved and changed in the last 20 years and more importantly, how it has evolved in the last several years.

Considerations should be given to the evolution of the ARPANET, the predecessor to the Internet, and how the Internet was used before the first graphic Web browsers. Teachers need to understand the evolution of FTP, Gopher, and Telnet sites, and how they impact the Internet today.

The Internet of the Present

When we look at the Internet of the present, we need to define the teacher's perspectives of the Internet. Teachers need to know the difference between the Internet and World Wide Web and the variations which exist within the realm of Web browsers and Web sites. Teachers need to understand the issues involved in using the Internet in the classroom such as Web propaganda, copyright, and "safe use" for students. Teachers need to be aware of acceptable use policies, security software, and safeguards for proper communication.

Internet of the Future

Although it has been estimated that 25% of the population uses the Internet, a dramatic increase is expected in Internet growth and usage during the next 10 years. There will also be much change in the ways in which we use and access Internet. The following are some of the areas in which rapid Internet developments will have an impact on the schools:

Conferencing

As the technology for video- and audioconferencing on the Internet becomes more efficient, it will become common to have two-way videoconferencing systems with interactive flatscreens in our homes, cars, and on our wristwatches. "Talking" will replace "typing" as a popular mode of communication. Not only will schools open their classrooms to the world but they will open the world to their classrooms.

Web Sites

Web sites in the future will be more interactive and involve conferencing. More students, teachers, classrooms, schools, and families will have Web sites.

Student will use Web sites to organize, to store notes, to conduct research, to complete homework, to access tutors, to build personal portfolios, to have access to records, and to communicate with experts and become involved in real world activities. Web sites will become an important learning component in schools of the future.

Usability

The Internet will become easier to use as we increase proficiency in technology and voice communication. Web sites will continue to improve in design and functionality.

We will see an increase in institutions, businesses, and organizations who will bring students into their interactive worlds. Teachers will be faced with a greater challenge to help students search, select, and evaluate an infinite amount of information.

Resources and Materials

As the Internet technology becomes more efficient in transmission and reproduction of audio and visual materials, the Internet will have the capability to replace many traditional classroom materials. With access to more resources, teachers will need to be prepared to meet the challenges of new Internet systems.

Summary

In summary, teachers need to realize that Internet of the future may change the way they teach and think about learning and communication in the classroom.

General Session: Staff Development

Where Is Everybody and Where Should They Be Going?

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Key Words: **staff development, proficiencies, competencies, turn-key trainers, certification, credit hours**

For those of us responsible for the staff development of hundreds of teachers, the planning process can be a nightmare. How can we measure the current level of proficiency for so many teachers? With self-assessment so notoriously inaccurate, how do we insure appropriate placements in classes? When districts send their teachers to a regional training center, how do they know exactly what they can expect from their teachers when the training is over?

To facilitate this process in Essex County, New Jersey, the Educational Technology Training Center (ETTC) created a matrix for assessing teacher competencies, establishing district priorities and credit hours for each course, and cultivating "turn-key" teachers. A list of "what every teacher must know to be considered technologically literate" provided the rows in our matrix; three columns were created out of three levels:

- apprentice skills classes focusing on the technology itself;
- practitioner courses emphasizing the use of the technology in the classroom; and
- expert seminars in designing interdisciplinary, multi-technology units and becoming certified by the ETTC as a turn-key trainer.

Using this relatively simple matrix, any school or district can graphically represent the status of technology staff development and more easily plan course offerings and calculate costs.

Topics include:

- Defining "technology literacy" for teachers
- Customizing a staff development program
- Creating a prerequisite ("novice") course to assure basic competencies
- Formulating skills classes with specific, standardized benchmarks
- Designing curriculum integration classes that promote individualization
- Developing a matrix that graphically illustrates teacher competencies school- or districtwide (suitable for presentations)
- Organizing "turn-key" training
- Attaching "credit hours" to courses for state certification or college credit

General Session: Curriculum and Instructional Strategies

Building Electronic Learning Communities: Using the Web for Professional Collaboration

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Key Words: electronic learning communities, asynchronous, synchronous, discussion, Internet, mentoring, moderator

This presentation will examine how the Center for Technology in Education (CTE) at Johns Hopkins University builds and sustains Electronic Learning Communities for educators in Maryland and beyond. The session will explore how such online communities can act as a dynamic resource for information exchange, discussion, technical assistance, and professional development.

A protocol for developing successful Electronic Learning Communities will be presented and discussed as a possible model for session attendees to use in their own projects. Lessons learned from implementing various projects will be shared, and guidance will be provided to those who are interested in similar Web initiatives. CTE's Web developer will be available to answer questions regarding technical issues of setting up and maintaining Electronic Learning Communities.

The following key components of Electronic Learning Communities will be addressed in the presentation:

Electronic Coaching and Mentoring

One of the goals of building Electronic Learning Communities is to provide support and assistance to educators who have specific problems or challenges in common. Online coaching and mentoring holds great potential for bringing educators together for peer support and to facilitate mentor/mentee relationships. One Learning Community currently in development by CTE is comprised of first-year principals who will provide peer support to each other and will be matched with seasoned school principals and administrators for additional support and assistance. Another community in development is comprised of all special education directors in Maryland, and will be similar in structure and purpose.

Synchronous and Asynchronous Discussion

One of the key strengths of the Internet is its ability to bring people together without regard to the traditional limitations of time and geography. CTE's Learning Communities support two forms of online discussion: synchronous and asynchronous. Synchronous discussions are utilized for online meetings, workshops, Q & A sessions with guest speakers, and one-on-one mentoring sessions in real-time. Asynchronous discussion forums allow users to exchange ideas by posting and reading messages on an online bulletin board, and are set up around any number of subjects.

Exchange

An important tool within CTE's Electronic Learning Communities is the ability for community members to share tangible products, such as files, evaluation reports, newsletters, samples of student work, curriculum plans, etc. Any type of electronic file can be uploaded to the exchange area, which consists of a series of online folders, the names and categories of which are managed by the community members themselves. This area also facilitates the exchange of calendars, URL's, and news bulletins.

Professional Development

Online delivery of professional development is an important goal of CTE's Learning Communities. CTE is currently supporting the delivery of several Web-based graduate courses for Johns Hopkins University, and has learned a great deal about the components of effective online instruction. CTE will develop and implement several online professional development workshops over the course of the coming year. Sessions will consist of both real-time and asynchronous interaction, and will involve pre-workshop activities and post-workshop evaluation and follow-up. In addition, traditional face-to-face workshops can be augmented and supported by the resources and tools within the Learning Community.

General Session: Staff Development

Measuring the Melding of Good Teaching Practice with Meaningful Technology Use

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Key Words: **technology integration, staff development, educational computing, teaching, learning**

It is not technology expertise, but rather good teaching practice that acts as the significant precursor to successful technology integration. Educators who see themselves as facilitators, who promote student collaboration, and who foster a willingness to innovate are poised to create new learning environments for today's digital world.

Models based on research are available to guide schools toward meaningful technology integration. The Apple Classrooms of Tomorrow (ACOT) Stages of Teacher Development were gleaned from more than a decade of research into how teachers adapt in a technology-rich setting. This general session kicks off with an introduction to the ACOT Stages, and how they may be utilized at the individual school site to allow each teacher to place him/herself along a continuum of technology integration. Educational computing may be implemented to support guided discovery and synthesis of meaning. The ACOT Stages provide teachers with a common vocabulary, as well as a way to measure where they are, and how to move forward, with the meaningful use of technology and good teaching.

Attendees will also be presented with an overview of the Levels of Proficiency, from the Los Angles County Office of Education. The Levels of Proficiency is a training-of-trainers model that expands the essence of the ACOT Stages towards maximizing effective innovation throughout a school or district. We will look at promoting innovative learning and technology integration strategies from the perspective of teacher mentors, staff developers, and administrators at the school and district-level. Finally, you will be introduced to a Technology Integration Inventory for Educators, which is designed to give precise and personalized feedback to educators about their progress toward a dozen technology integration competencies. Finally, we will see how the skills measured by the Inventory complement the International Society of Technology in Education's Strategies for New Learning Environments.

Together, these models and tools can help us flesh out a clear image of powerful teaching and learning for the 21st century. They provide a way to measure progress towards meeting the formidable responsibility educators have to create new learning environments for today's digital world.

General Session: Curriculum and Instructional Strategies

InTech 2000: Making Technology Happen

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Key Words: **staff development, Internet, administrators, technology integration, InTech 2000**

This unique master trainer program, developed by the Florida Technology Trainer Enhancement Center at the Miami Museum of Science, through funding provided by the Florida Department of Education and BellSouth Foundation, provides school leaders with the tools necessary to effectively implement, manage, and assess technology integration at the school level. The latest component of the InTech 2000 series, this program is specifically designed to meet the critical need for training school level administrators in supporting teachers' efforts to incorporate technology into the curriculum at all instructional levels.

Session participants will be exposed to training materials from the program, including the following modules:

- Creating a Vision for Change
- Using the Internet Effectively as an Educational Tool
- Basics of Computer Networking for School Administrators
- Integrating Technology into the Classroom
- Empowering Others Through Staff Development
- Tips for Success

Additionally, an overview of hands-on training modules in navigating the Web, e-mail, and the use of electronic presentations in school settings will be presented.

An Administrator's Toolkit of materials that support the Institute Training is provided to those who complete the training program. The Toolkit includes:

- A CD-ROM with Learning Cards and Trainers' Manual in PDF format
- The InTech 2000 Hotlinks for School Administrator's Web site (http://intech2000.miamisci.org/adminlinks) designed for the specific needs of school administrators to get information and research to support effective school operations
- Follow-up telecommunications support.

Additional materials include needs assessment instruments and copies of the latest research to compliment the Institute activities and provide on-going support for school administrators throughout the state of Florida.

Research indicates that one of the most important factors in successful schools is positive administrative leadership. This training program provides school leaders with the tools needed to assist them in developing and implementing a successful vision for the integration of technology into the curriculum

Virtual Tour of Texas's Lighthouse District for Technology Integration

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Key Words: technology integration, staff development, infrastructure design

Named the Lighthouse District for Technology Integration for the state of Texas by Commissioner of Education, Mike Moses, Allen Independent School District stands as a well-known leader in technology and has become a state and national visitation site. Allen is the second largest district in Texas to gain the recognition of being rated Exemplary by performing in the upper ninety percentiles on state achievement tests. In Allen, instruction pushes technology and Marci Powell, Technical Coordinator, has coordinated infrastructure design and implementation, technical support and been an integral force in technology-based staff development. Texas Computer Education Association named Powell the 1998 Technology Support Person of the Year. Penni Jones, Director of Curriculum and Instruction, has been instrumental in establishing a strong technological foundation. Under Jones's direction, Allen ISD has become a showcase for the nation.

Five years ago, the Allen ISD had a few Macintosh computers. Now, the district is PC-based, has Internet connectivity to every classroom, WAN, laptops for administrators and teachers, more than 2,000 computers, and a solid technical support program utilizing faculty, technicians, and students. On this tour, attendees go behind the scenes to see how the infrastructure was built and paid for, and how technology was successfully integrated into the curriculum.

Attendees virtually visit labs such as the Livewire, a lab designed by students to resemble a fifties diner. In this environment, students and community members can sit in a booth or at the counter and order software off the menu. Open six days a week, 7am to 9pm, the open lab has computers, color laser printers, video editing, and CD burners. Students show parents their presentations or html Web page designs or coach them in learning a particular software program. Community members can do Web research or download programs. Authorware software is available to develop software or games. Some other labs are using videoconferencing, Robotics, the Brain Gym, COWS (Computers On Wheels), and Cybercave.

All students use Microsoft Office products. Third graders might use Excel to create a list of plant classifications and a first grader might create an "All About Me" PowerPoint presentation. Students begin keyboarding in kindergarten. All 11 campuses host a daily news broadcast. Allen students use videoconferencing to participate in collaborative projects with students in Laredo, 600 miles away. All teachers have Web pages and students create sites for area businesses. Allen students have received several of the highest achievement awards in CyberFair, an international Web design competition.

Our SHIFT program has received overwhelming recognition. Students Helping Integrate Future Technologies powerfully impacts technology integration, technical support, and staff development. SHIFT students come on a moment's notice to troubleshoot, serve as facilitators in the lab for a teacher, or deliver one-on-one tutoring to the instructor. Teachers can utilize technology without being an expert in software.

Instructional Designers work with faculty on implementing technology into lesson plans and set standards and competencies to be attained by both faculty and students. Technology progress report cards for all grade levels are sent to parents every six weeks. Staff development programs such as Frequent Appliers, New Millennium Mentors, STAR Search, Mini grants, CompUSA bucks, and Master Monday have been successful in building excitement and confidence.

Research Paper: Curriculum and Instructional Strategies

A Self-Fulfilling Prophecy: Online Distance Learning for Introductory Computing

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Key Words: **online courses, distance learning, Web-based education, computing literacy**

Abstract

This paper describes novel approaches for adapting an introductory computing course for online distance learning, including discussions of the underlying pedagogy and objectives as well as the implementation and results of the actual course.

Introduction

Early efforts in the arena of distance learning followed a fairly standard "correspondence course" paradigm: students armed with texts and course notes studied prescribed material, and mailed work back to campus to be evaluated. Letters and perhaps an occasional phone call with the instructor were the only forms of interaction. Because each student took the course independently, there was no notion of a "class" and the time frame for completing course work was arbitrary.

From this starting point, the methods for distance learning have evolved along with technological advances. The mode for content delivery changed as lectures on first audiocassette and then videocassette replaced notes. The advent of telecommunications brought with it a myriad of possibilities, including distance learning in a distributed class format. In this format, students across the globe can be linked as a single class through televised satellite communications (NTU, 1999). Because students collect for class meetings at designated sites over a particular time period, such courses represent a radical departure from the original "correspondence courses" in which isolated students work asynchronously. Unfortunately, such courses also require sophisticated teaching/learning environments, and many institutions lack ready access to the necessary resources.

The current proliferation of the Internet and World Wide Web (Web) has made yet another paradigm for distance learning possible: the online course. In such courses a Web site serves as a repository of course materials, providing access to expository material, interactive labs, and exams. Students interact with both the instructor and classmates via e-mail, bulletin boards, and/or chat rooms (ACCESS/NJIT Distance Learning, 1998). Although the interactivity of such Web-based courses cannot hope to match what is possible with teleconferencing, no special resources are required to offer such a course; any institution with a reasonable Internet connection is suitably equipped.

In this paper we describe novel approaches for adapting an introductory course in computing for online distance learning. These approaches were motivated by two fundamental goals. First, in light of the obvious educational disadvantages of distance learning, we decided that the online elements of the course must effect offsetting educational advantages. This meant creating positive educational experiences not possible in other formats. Second, we wanted the course to be as accessible as possible, keeping the economic and related technological requirements to a minimum. The course should require neither sophisticated equipment nor expensive software; any off campus student with access to a PC, a modem, and a suitable connection to the Internet should be able to participate, for about the same expense as any other course. Our challenge then was to provide an enriched educational experience online, subject to these limitations. In this paper we discuss the underlying pedagogy and objectives of our course design, as well as the implementation and resulting successes and failures of the actual course.

The Original Course

The course we chose to adapt to Internet delivery is an introduction to computing, with no prerequisites. Students study the history of computing, their impact on society, and standard applications, especially those related to the Internet and Web (e.g., e-mail, search engines, and Web navigators). Students are also exposed to basic computational problem solving using, for example, the BASIC programming language. Current on-campus versions of the course are taught in a discussion/lab format. Discussions address historical and societal issues, and provide an opportunity for the instructor to introduce technical subject matter. The technical subject matter is extended through instructor guided, hands-on experience in the labs. Student work in the course typically includes written themes on societal aspects, the creation of Web pages, assorted artifacts of Web browsing (e.g., electronic postcards to the instructor, links to credible Web reference material, etc.), and programs.

The course is also distinguished as a junior level elective serving a bimodal student population. One population taking the course is Computer Information System (CIS) majors for whom the course satisfies an upper level elective requirement. The second population consists of non-majors, for whom the course fulfills a university-wide "Science and Technology" requirement.

Design of the Online Course

In this section we describe our major objectives and approaches to the course design.

Instructional Strategies

In considering how the Internet could be used for distance learning, we identified three major instructional strategies which would be unique to the online version of the course, and which held the potential for a quality educational experience not otherwise possible.

Class Cybersociety

One of the major societal impacts of the Internet is the development of online "cybersocieties," societies defined in and by a virtual environment (Bruckman, 1996). Students in the course would develop an understanding of the effect of cybersocieties on human interactions by actually participating in one. For instance, through online class discussions students would experience firsthand how the anonymity factor inherent to this kind of communication effects their interaction (Turkle, 1996). In fact, each student's class identity would be established entirely online. (Unlike an on-campus exercise to simulate the effect.) Class interactions with the professor and classmates would only occur via e-mail, bulletin boards, and (at scheduled times) meeting in chat rooms. (A bulletin board is an asynchronous form of communication, in which each participant reads messages and posts their own replies at different times, according to their own schedule. In contrast, a chat room supports the synchronous exchange of messages among participants.) Because fostering a vital electronic community would seem to be better facilitated by intense involvement, we decided to run the course in a shortened (five-week) time frame, similar to the summer school sessions at many institutions of higher learning.

Online Student Portfolios

Students would not just create a page or two, but develop an entire electronic portfolio as a Web site. Each individual student portfolio would include links to papers, programs, and other assigned Web pages. Students would access each other's sites for peer review and as a basis for discussions. A student's portfolio would not only establish their identity in the class cybersociety, but would also be a significant element of their course assessment. The additional benefits afforded by portfolio assessment are well documented (Adams & Hamm, 1991; Hart, 1994).

Self-Guided Online Labs

Using computing as the instructional medium for a course about computing seems exceptionally appropriate. Indeed, the students' experience with the technology that supports the online course (e.g., standard Internet applications) is part of the requisite subject matter. This primary objective of the course becomes a self-fulfilling prophecy. Initial lab work must facilitate students downloading and installing any needed software. Further labs must address the variety of Internet tools that are used. For example, in addition to the class interactions previously described, students will download software across the Internet, use search engines, and navigate to class notes and other materials on the course Web site.

Resources

In keeping with our goal of accessibility, we decided that the course would be offered requiring as little computational power as feasible. Obviously, taking a course online requires a computer, a modem, and a connection to the Internet. For ease in initially developing the labs, we decided that we would start by supporting only the Windows platform. The requisite software will dictate the requisite computational power of the machinery. For the economic considerations previously mentioned, all course software should be either commonly available (e.g., word processor, spreadsheet, etc.) or be in the public domain. We selected Netscape Communicator for Internet software services, including browsing, e-mail and FTP, as well as for HTML editing. A more difficult issue was that of the computational problem solving aspect of the course. This portion of the course had frequently been taught using languages that required access to departmental machines with the necessary translators. However, one version of the course was notable in that it had used a programming language that avoided this requirement: the PostScript printer programming language.

All of the basic constructs of computational problem solving are readily accessible in the PostScript language. About one third of the PostScript language is devoted to graphics. The remainder makes up an entirely general purpose programming language including variables in the most common data types (reals, booleans, arrays, and strings), procedures, and control structures like loops and conditionals (Reid, 1988). While application programs usually generate PostScript programs, these programs are ordinary text files of printable ASCII characters, and can also be generated by human programmers. To view the results, neither a proprietary translator program nor a PostScript printer is required. Students can examine the output graphical images using public domain software like Ghostscript/GSview.

Finally, while learning the PostScript language is arguably of little utility to students wanting to program, learning to program in any language is not an objective of this course; too little time is available to achieve that goal. Rather, students are merely intended to develop an appreciation for the complexity of software development, and the difficulty of producing error free programs.

Implementation of the Online Course: Successes and Failures

The course was offered for the first time in a five-week summer session of 1998. In this section we will describe the more salient features of the course implementation, and how well the implementation met the design objectives.

Student Demographics

Ten students initially enrolled in the course. Three of them were computing majors (computer science, computer information systems, or business computing) and one was a university employee in computing services. Nearly all were already well versed in word-processing, spreadsheet, and graphics programs. As would be expected, the computing majors also had the benefit of previous programming instruction, and various levels of experience writing html, administering Web sites, and using Internet applications. While several students were actually on campus or working in town during the course, none of these students had face-to-face or telephone contact with the professor during the course. Of the 10 students initially enrolled, six of them eventually completed the course.

Instructional Strategies

Class Cybersociety

The course bulletin board was our primary vehicle for class communication. Each discussion concerned a specific topic and lasted for a certain time frame. For example, the discussion on technical issues was ongoing throughout the semester, while each discussion on a particular reading assignment lasted only a few days. The topic of each discussion was introduced by a base message posted by the instructor. (An excerpt from such a base message for a discussion on a reading assignment appears in Figure 1.)

> In an online course, where we are dependent upon our computing resources for our course work, it seems appropriate to begin our consideration of the societal impact of computing with issues of reliability. A famous computer scientist Edgar Dijkstra once stated: "Testing can reveal the presence of errors, but can never guarantee their absence." … What, if any, standards of reliability can be enforced? Should reliability have to be approved by a government agency before release? If so, should it be necessary for all systems or only "critical" ones? And just what should be considered "critical?"

Figure 1. An excerpt from a discussion base message

Student participation in these discussions accounted for 20% of their course grade, and their postings were evaluated according to the criteria summarized in Figure 2.

Unfortunately, the creation of a dynamic class cybersociety was hampered by two problems that ultimately plagued much of the course, in some fashion or another. First, while enrollment was limited to avoid instructor overload in these experimental courses, it did not account for the higher attrition rate generally experienced by these types of courses. The eventual class size ended up too small. The second problem stemmed from the combination of the time frame for the course and student expectations for the distribution of their time commitment. Student motivation for taking this or any online course is generally the freedom it provides from the time and place restrictions of class meetings.

Topical
A good message should be relevant to the current subject matter.

Concise
Messages several screens long do not get many replies - attempt to use a single screen.

Provocative
A good message is one that prompts others to reply.

Substantial
A good message either poses an interesting question, or provides a knowledgeable answer which explores, explains or expands a concept.

Timely
Replies to other messages must occur in a timely fashion for an effective discussion to occur.

Logical
A good message that is not a question should contain a clearly stated thesis supported by factual evidence and valid inferences.

Grammatical
The use of grammatical English is especially important for our (potentially) international audience.

Figure 2. Evaluation criteria for bulletin board postings

However, there are different degrees of freedom possible. A course may be entirely asynchronous, allowing each student to proceed at their own pace. Or it may be synchronous, and force students to operate within strict time frames. Clearly, a dynamic, interactive course with class discussions requires the latter. In a course taught in a shortened, summer school session, these deadlines must necessarily occur at a fast and furious pace. A truly interactive environment would require every student to participate on *at least* a daily basis. This conflicted with most of the students' expectations for the degree of scheduling freedom allowed by the course.

In fact, most students had travel or other commitments that kept them offline for days at a time. Even under normal circumstances, most seemed to log onto the system only immediately before scheduled deadlines. The result was that each student usually made only one posting to a particular bulletin board discussion, and this posting often responded only to the base message, as though it were a singular essay question. Further, student time commitments made the scheduling of regular online class chats impossible. In short, the course goal of interactivity failed.

Another difficulty in achieving the envisioned class cybersociety was also experienced by Amill, Harris, Jones, and O'Bryan (1997) in their effort to network educators and experts. In their work, the authors found that electronic mail "requires somewhat different interaction strategies if it is to be used to create maximal educational benefit ...." The same is equally true for any written, electronic communication. The critical role of a discussion moderator, particularly to challenge ideas and force interactions, cannot be overstated.

This aspect of the course, however, was not entirely without success. Additional inter-student class communication was supported by a student contact page which provided classmates with each other's e-mail address and home page URL. This mechanism led to spontaneous occurrences of collaborative learning, with computing majors coming to the aid of the other students in the course. While students could have solicited this aid either privately from the instructor through electronic mail or publicly from the instructor and/or other students through the bulletin board, they were largely more comfortable seeking out each other's help individually.

Online Student Portfolios

Each student created a Web site as an electronic portfolio of class work which was assessed 1/2 on its presentation as a Web site and 1/2 as a portfolio of intellectual development (as related to course content). Like the course discussions, this work accounted for 20% of each student's course grade. Also like the course discussions, the development and use of the portfolios was hampered by the shortened format of the course. A "portfolio documents learning over time. It is this long-term perspective that makes portfolios such a useful assessment tool" (Hart, 1994). While the specific duration of time necessary to achieve this benefit from portfolios is not clear cut, the five weeks allotted to this courses seemed insufficient. Further, the Web sites were not substantially in place until it was too late for their envisioned use as individual identities within the cybersociety. Finally, there were significant student concerns over this type of assessment. While students were provided with descriptions and examples, these seemed insufficient to allay their uneasiness. In the future, we hope to provide explicit, step-by-step guidelines for the development of this documentation.

Self-Guided Online Labs

Various homework assignments throughout the term, required students to download, install, and use course software. Online tutorials for accomplishing these tasks were collectively provided by the course Web site, the university's computing services Web site, and other dedicated sites (Bradley University, 1998; NCSA, 1998; Using Composer, 1998). The public domain software finally used included: WinZip, Netscape

Communicator, QVT/Term, and Ghostscript/GSview. As was indicated by the course demographics, the students drawn to this course were already computer savvy. In light of this fact, judging the effectiveness of these labs and technical support in any meaningful way is not really possible. Only one student, a computing major, reported encountering any difficulties in installing or using course software.

Resources

The technical support of the course was provided through usual campus computing services as well as our Center for Asynchronous Learning which supports a beta implementation of the CyberProf software developed at the University of Illinois, Urbana-Champaign. This software provides an environment for the development and integration of World Wide Web teaching resources, including Web page templates, bulletin board and quizzing facilities, and grade keeping features. In addition to discussions, homework, and portfolios, we had intended to assess student performance using quiz items developed in CyberProf. Unfortunately, this part of our installation of the software package has been bug-ridden and was unavailable for use. When the full release of CyberProf becomes available, we expect that the creation of these items will be a significant part of this course's continued development.

As was previously discussed, the PostScript printer language was used for teaching computational problem solving in the course. Homework assignments ranged from modifying existing programs to writing small programs from scratch. Online tutorials for using the PostScript language were, like the other described lab work, supported by the course Web site and other dedicated sites (Weingartner, 1997). While the primary motivation for using this particular language was to minimize the required resources, in the end analysis the use of this language was highly successful for a couple of additional reasons. First, the graphical nature of the output (e.g., a box) seems much more gratifying to many students than textual results (e.g., Hello world!). Visual learners are particularly aided by this approach. Also, PostScript is an interpreted, stack-based language similar to FORTH; Figure 3 gives an example program and Figure 4 shows the output produced.

```
%!
% This program repeatedly prints the
% string “NECC” in increasingly
% darker shades of gray.
%-----------Procedure-----------
% This procedure prints the string
% “NECC” at the current origin.
/printNECC
  { 0 0 moveto (NECC) show} def
```

Figure 3. An example PostScript program

(figure continues)

```
%-----------Main Program-----------
/Times-Italic findfont 30
scalefont setfont

% move the origin of the coordinate
% system to the middle of the page
320 400 translate

% start, increment, and end values
% for the loop counter
.95  -.05 0 {
  % set gray based on the loop
  % counter on top of the stack
  setgray
  % print the string "NECC"
  printNECC
  % move the origin of the coordinate
  % system up and to the left
  -1 .5 translate } for

% print "NECC" one more time,
% this time in white
  1 setgray printNECC
showpage
```

Figure 3. (continued)

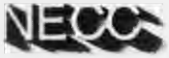

Figure 4. The output of the example PostScript program in Figure 3

This programming model is quite different from the C++ world in which our computing majors do the bulk of their course work. This fact has a couple of happy consequences. Often the computational problem solving portion of this course suffers from the bimodal nature of the student population. Either the computing majors in the course end up bored, or the other students end up confused. Because PostScript is so dissimilar to our typical computing major's previous experiences, this problem is avoided. Further, our majors have the added benefit of extending their experience base in programming languages.

Conclusion

We have discussed the underlying pedagogy and objectives as well as the implementation and results of an online course in introductory computing. Our ultimate goal was to provide an enriched educational experience, subject to economic and related technological limitations. While the accessibility of the course was successfully maintained, several of the teaching methods meant to enrich the experience were significantly hampered by the shortened time frame in which the course was offered. Currently, the course materials are in revision for a future offering during a regular, 15-week semester. The course will also be more actively marketed to draw in the computing novices who have the most to gain from the self-fulfilling prophecy of an online course in introductory computing.

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K12-Search: An Internet Search Engine Interface for Teachers and Students

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Key Words: **Internet, search engine, information literacy, K–12**

The Internet can provide access to a wealth of information that can be useful to both teachers and students. However, too often the utility of Internet content must be weighed against the effort a child or teacher must expend to find material suitable for a particular lesson. Simply put, searching for information on the Internet can be time consuming and frustrating. One variable confounding a better match between the needs of educational institutions and the power of the Internet is the dependence on traditional Web search engines to find appropriate educational material. These Web search engines provide raw horsepower, but offer little assistance in guiding and harnessing this power. In other words, Web searches often suffer from high recall (many useful things found) and low precision (even more useless things found). Teachers, and especially children, do not have the time or the attention span to sift through large numbers of documents to find the few of interest.

K12-Search is developing software that helps bring the power of the Internet and Web search engines to the classroom in a form suitable for teachers and students. K12-Search is a new graphical user interface developed exclusively for K-12 schools and their specific needs. For example, K12-Search makes it easy to locate relevant and age-appropriate material on the Internet.

The K12-Search interface guides students through the process of formulating and describing their information needs. Modified versions of traditional information retrieval (IR) tools will transform the information need into a search query, utilizing knowledge of teacher objectives, student level, and subject matter. The intent is to let children express their information needs in English, have the software transform it into a complex structured query, and pass it off to the Web search engine. Returned results are organized automatically, using clustering and machine learning techniques. This is viewed as a "second stage" of searching, done at the interface, in which results are organized and further filtering takes place.

In addition to the search interface, a series of lesson plans are being developed and utilized to help introduce students to the Internet. Specifically, students are learning (in simple terms) what the Internet is, how to use the Internet to find information, and gaining information literacy skills so they will be more intelligent consumers of Internet related information. Presently, the software prototype as well as the information literacy lessons plans are being used with approximately 100 fourth grade students in Western Massachusetts.

K12-Search is a joint effort of the University of Massachusetts Center for Intelligent Information Retrieval (CIIR), Westfield State College, the University of Massachusetts Library, Javanet, and Merriam-Webster Inc. K12-Search is funded by grants from the National Science Foundation, Library of Congress, and Department of Commerce (award IIS-9812358 and cooperative agreement EEC-9209623).

Topics Include:

- A demonstration of the search attributes of the K-12 Search software
- Particulars of how K12-Search works and was developed
- A presentation and discussion of Internet/Information literacy lesson plans developed for elementary school students
- A sharing of information based on experiences in schools
- Future goals

General Session: Staff Development

Starting with Standards: Creating a Professional Community on the Web

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Key Words: **standards, professional development, online communication**

Career Connections to Teaching with Technology (CCTT) represents six schools and districts from throughout the United States, together encompassing the geographic and cultural diversity of our nation. This partnership is facilitated by a U.S. Department of Education Challenge Grant administered by Volusia County Florida.

The goal of the project is to increase student achievement in core academic areas by creating career connections to learning using existing and emerging technologies.

We have established a process for creation, submission, and revision of units and lessons. We are also building a database of curriculum established using national standards and supported by a diverse professional development model, beginning with standards and integrated technology. We have also established a procedure for collegial support by providing online communication tools for use within the consortium, connecting teachers with each other and with content specialists representing national education organizations.

We have developed a Unit and Lesson Plan Organizer, which is driven by the national standards. We want to share our processes in working with standards-based lessons, as well as the diverse staff development model which has made this possible. We will discuss the community we have established among our national content specialists and our six hub sites.

General Session: Curriculum and Instructional Strategies

Developing Virtual Museums: 4Directions Schools and the National Museum of the American Indian

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Key Words: **virtual tour, virtual museum, QuickTime VR, American Indian education, school-museum collaboration, World Wide Web, Internet**

The 4Directions project, funded by a U.S. Department of Education Challenge Technology Grant, supports 19 Native American schools that are using information technologies to support culturally responsive curriculum. It has received the Government Executive Magazine award for outstanding and innovative use of technology. The National Museum of the American Indian (NMAI) is a branch of the Smithsonian institute that manages and displays the institute's vast Native American collections.

The NMAI Customs House facility in New York City displays selected holdings in elaborate installations with authentic contexts. These exhibitions have the potential to provide important learning experiences for Native American students and community members, who share a great concern about culture and language loss. Unfortunately, American Indian schools rarely have the resources to fund field trips to examine these exhibits. Also, NMAI can display only a tiny fraction of their holdings, and the exhibitions change regularly.

In the fall of 1998, the 4Directions project and the NMAI embarked on a collaborative project for creating virtual museums incorporating NMAI holdings. 4Directions schools will send teams of students, teachers, and tribal elders to the NMAI Customs House facility to design and assemble a virtual tour of the museum's current exhibit as it relates to the school community's culture. A version of the virtual tours will be posted on the museum's home page. More elaborate, detailed virtual museums will be targeted for implementation on CD-ROM.

A variety of information technologies will be used to capture the essence of the museum's objects for the virtual displays. Digital sound, graphics, photos, video, and QuickTime VR will be added to the text of the virtual tours to give visitors rich immersive experiences accessible on the World Wide Web. In developing the virtual museums, 4Directions students and teachers will gain hands-on knowledge and skills using 21st century technologies for learning. The virtual museum projects will provide an important forum for community outreach and collaboration, adding the voices and honoring the values of specific Native American communities to NMAI's mission.

When completed, the virtual museums will enable Native American children to study, learn about, and value their own culture, language and knowledge. The virtual museums will work toward the preservation of American Indian cultures and languages. They will make the invaluable holdings of the NMAI more accessible to Native American communities, and the world.

Paul Resta will introduce the 4D/NMAI Virtual Museum collaboration. Shelly Valdez, director of the 4Directions project, will give an overview of the goals and objectives of 4Directions and how they mesh with the 4D/NMAI collaboration. Marty DeMontano, project director for NMAI, will explain how the Virtual Museum collaboration furthers the mission of the museum. Teachers and students from one of the 4Directions schools (T.B.A.) will talk about their experiences in producing their virtual museum and demonstrate their work.

General Session: Using Technology to Facilitate Learning

Meaningful Expression (Storytelling/Constructing) in the Digital Age: Discussion on Multimedia Insights

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Key Words: **multimedia, storytelling, creativity, curriculum, classroom technology**

Multimedia tools are now more popular and easy to use than ever, but what are students creating with these communication tools? This interactive presentation will spark discussion on how we can move educators and learners beyond "the frog's digestive system" with PowerPoint. How can we challenge students to create meaningful and moving stories? How can these stories help teach and inspire? How can multimedia storytelling be used to share what students know, what students wonder about, what students hope for the future? This panel of provocative thinkers, storytellers, and educators will share their insights while inviting active dialogue with the audience.

Topics include:

- Challenging students to do their best
- How to go beyond prescripted lesson plans
- Expecting the unexpected
- Using constructionist software (e.g., HyperStudio, Logo, MicroWorlds) to create authentic projects
- Encouraging students to use media for purposes to help inspire and inform
- What does "meaningful" mean?
- Seizing the magic of computing to learn new things in new ways

Internet Delivers Educators a New Way to Teach Cold War

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Key Words: **Internet, curriculum, Cold War, primary sources, CNN, video, CD-ROM**

Most of us who are old enough to remember the Cold War have vivid memories—from Duck and Cover exercises in school, to newspaper headlines highlighting the missile gap, to television coverage of the Vietnam War. But for a generation of students, many of whom are too young to remember the fall of the Berlin Wall, the Cold War is just a series of distant events chronicled in a textbook.

CNN's *Cold War*, a 24-part documentary series, examines this defining struggle of our time. The first major documentary on the subject, *Cold War* weaves together more than 1,000 hours of original footage and more than 500 interviews with eyewitnesses to the Cold War from over 30 countries to tell the compelling story of the second half of this century. To complement CNN's series, CNN Interactive developed www.cnn.com/ColdWar/, the most comprehensive online site ever produced for a television documentary. This site brings history alive through multimedia-rich features and interactivity. And, with the fall of the Iron Curtain, thousands of primary sources documenting this history from both sides of the divide are now available on the Internet.

A resource like this has a place in every school media center. But for teachers, who spend limited time teaching the Cold War, CNN's 24-hour documentary, complementary Web site, and extensive library of primary documents can seem overwhelming. To help teachers integrate *Cold War*, the companion multimedia Web site, and the primary documents into the classroom, Turner Learning, the educational division for Turner Broadcasting, developed a reference guide in both CD-ROM and Internet formats. The Educator Guide integrates video, audio, text, and the Internet to make this wealth of information accessible to teachers.

Through segment summaries, discussion questions, activities, timelines, and excerpts of newly released primary sources, the interactive Educator Guide provides the bridge between the Cold War era and the school curriculum. Hyperlinks to the CNN

Interactive Cold War site provide teachers and students access to biographies of Cold Warriors, interactive maps, episode and interview transcripts, streamed audio and video, interactive games on Cold War decision-making, interactive tours of Cold War hot spots through IPIX, and Cold War message boards and polls.

In addition, links are provided to the Cold War International History Project, National Security Archive, Library of Congress, and the National Archives provide newly released documents from both sides of the Iron Curtain. Teachers can use these documents to have students do authentic historical analysis—never before could students relive moments in history through such a powerful mix of text, audio, and video. This flood of documents coming from East bloc archives and top secret U.S. government files now makes it possible to be a "fly on the wall" of history.

Using these powerful multimedia resources, teachers will be able to integrate CNN's *Cold War* series into the classroom for years to come. This educational extension gives the *Cold War* series perpetuity in the classroom that surpasses textbooks. Generations of students will be able to experience recent events, now considered historical, and be able to analyze their significance from multiple perspectives. *Cold War* provides them with a front-row seat to the key Cold War events, an avenue into the minds of the decision-makers and a personal connection to those who witnessed the results of these decisions firsthand. By participating in authentic and project-centered activities, students will no longer see the Cold War as a distant series of events but rather will be engaged in the process of "doing history."

General Session: Curriculum and Instructional Strategies

Using Technology to Link Schools and Communities in Urban Classrooms

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Key Words: **project-based learning, communities, urban schools, video**

This session will present one project that has emerged from a joint effort between the University of Pennsylvania and West Philadelphia public schools to improve the integration of technology into the curriculum. Specifically, we examine a project aimed at fostering students' learning about their neighborhoods through the use of technology. This and many other technology-related projects throughout West Philadelphia are funded by the Technology Challenge Grant, an initiative of the U.S. Department of Education; and the Link to Learn Grant, administered by the Pennsylvania Governor's Office and Department of Education.

Across the country, urban schools are struggling with the dual challenges of improving education for their students while attempting to strengthen and support the communities in which they live. One promising development in this struggle is the development of curricula which focus on community problem solving. Technology stands to play an important role in this process for a number of reasons. First, it helps to engage students in project-based learning. Second, it serves as a vehicle for obtaining valuable data for community oriented research. Third, technology enables students to analyze the information they collect, assess community problems, and identify solutions. Finally, technology enables students to publicize their work locally, creating a link between classroom activities and community involvement.

Our presentation will focus on a single project based at West Philadelphia High School, a school of roughly 1,800 students serving a low-income, predominantly African American neighborhood in West Philadelphia. Like all schools in Philadelphia, West is divided into Small Learning Communities (SLCs). This year one SLC decided that it would launch an ambitious, interdisciplinary curriculum entitled "West Philadelphia: Who We Are." One important component of the curriculum was a project developed by Carol Merril-Bright, an English teacher, and Mardys Leeper, the Computer teacher. The project involved the use of film, digital video editing, and multimedia production for students to prepare presentations about themselves and their communities. Over the summer, a group of students worked with Merril-Bright on developing two videos related to community studies. First, they produced a short video about long-time West Philadelphia resident Paul Robeson; a project that included conducting interviews with members of local community and cultural groups about Robeson's life and importance to the community. Second, they began production of a video about West Philadelphia, and how students are getting involved to help improve conditions in their neighborhood. Work on this project continues into this school year.

Video production required that students develop numerous technical and analytical skills. (A video education consultant has been hired on a part-time basis to work directly with the teachers and students.) First, they learned to shoot and edit video. Both tape and digital video were initially used, with digital video gradually replacing tape. Second, they learned how to turn raw material into a well-organized finished product. Finally, students began the process of learning about their neighborhood. As the project continues into this year, the students will continue to produce video, but they will also develop a multimedia component. By the second semester of this year, students will be incorporating their own videos into World Wide Web sites that provide information about "West Philadelphia: Who We Are."

Those who attend this session can expect to: (1) gain a general understanding of the role of community studies curricula in strengthening urban education while improving neighborhoods; (2) learn about the role of technology in making community studies projects happen in their classrooms; (3) learn specifically how two teachers went about designing and implementing one such project in their classrooms; (4) begin to develop a framework for understanding the ways that technology can mediate the relationship between school and neighborhood in their own communities; and (5) learn about effective and innovative university and K-3 partnerships.

General Session: Using Technology to Facilitate Learning

Visual Literacy: A New Rationale for Teaching with Technology

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Key Words: **visual literacy, visual media, educational technology, technology effectiveness, intelligence, workplace equity**

Funding agencies have been pleading for years for an answer to the question: What is the return on education's investment in technology? Current research tends to rely on "conjectured correlations" between technology and educational improvement, but solid evidence is difficult to find. Recent findings on visual literacy, however, may offer a more concrete rationale. Visual literacy may show us how using technology in certain key ways can help develop learning skills that are so important, they are considered a kind of intelligence.

Defining Visual Literacy

Visual literacy has varying definitions in the literature. Some educators emphasize the need for "visual communication" skills (Box & Cochenor, 1995), while others spotlight critical analysis of visual images and visual information (Couch, 1995). Christopherson's (1997) more encompassing definition is: "critical ability which will enable (people) to use visual images accurately and behave appropriately" (p. 169). In his view, visually literate people can: interpret, understand, and appreciate the meaning of visual messages; communicate more effectively through applying basic principles/concepts of visual design; produce visual messages using the computer and other technology; and use visual thinking to conceptualize solutions to problems.

Current Research Directions

Neisser (1997) has studied trends and issues in intelligence testing which indicate that IQ scores have been rising since the tests were first given. He feels that these gains are "Far too rapid to result from genetic changes" (p. 442) and suggests they may be due to an "increase in exposure to many types of visual media" (p. 446). He cites UCLA research which finds that "children exposed to these media develop specific skills of visual analysis, skills in which they routinely excel their elders" (p. 447). Finally, Neisser points out that subtests that relate to school content show the smallest increases because they have so little to do with visual analysis skills. He concludes that we are "indeed very much smarter than our grandparents where visual analysis is concerned, but not with respect to other aspects of intelligence" (p. 447). Christopherson (1997) gathered other compelling evidence of the importance of visual literacy skills by focusing on the relationship of visual literacy to school skills. His findings indicate that "students with visual communication skills are more marketable" (p. 174).

Implications for Technology in Education

A powerful rationale for using technology in teaching may emerge from this combination of findings. If visual skills correlate so highly to abilities considered fundamental to intelligence and to performance in technical content areas, it seems a logical corollary that school skills should focus more on visual skills—both on teaching them and on using them in various content areas. And, if this is true, the use of technology is of undeniable value. These findings have several implications for school practices related to technology. This presentation will discuss these implications as they relate to: teaching methods (using technologies to develop visual literacy skills); teacher training (demonstrating the link between technology skills and visual communication skills); and equity (using visual literacy training to increase numbers of females and minorities in technology-intensive areas, e.g., science and engineering).

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General Session: Exhibitor

Multimedia Software and Language Arts Education

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Key Words: **technology in the classroom, writing process, writing, Internet, writing projects, publishing, technology**

English language arts educators have begun to find ways to incorporate aspects of technology into their classrooms. Yet, much of this use centers around a computer's word-processing abilities or "hunting and gathering" on the Internet. Technology today is capable of expanding far beyond this use. With an interdisciplinary approach designed to engage students in the writing process, technology can provide transformational reading and inspire meaningful writing.

Quality academic software, when linked to the Internet, gives students access to a global network of people and ideas, a plethora of media, and an authentic audience for the work they create. Literature, film, art, science, music, research, and the many other things that inspire professionals to write are what will inspire our students to write. Today's savvy students need to see that their writing tasks are relevant and applicable to the world they know. Computers are multimedia tools that can interweave these varied resources into a powerful learning environment. Having easy-to-use on-screen and online lessons and resources enables teachers to focus on what only they are able to do: interact with students and provide individualized feedback and assessment.

ED-Vantage's approach to language arts software was inspired by the interactive pedagogy of James Moffett. To date, the company products include Codie nominated Writing Trek series and The Writer's Resource Library. Each lesson has a one-click link to a student-centered Web site and publishing network. The company's development team includes classroom teachers, National Writing Project directors, NCTE officers, professional writers, and editors. Using ED-Vantage materials as models, the general session will address the following topics:

- The use of single or multiple computers in a classroom
- Teaching across the universe of discourse
- Incorporating interdisciplinary projects into the writing classroom via technology
- Getting students engaged by finding points of entry
- Social interaction as it pertains to the use of technology
- Using the Internet to publish to a real audience
- Interacting with and responding to the work of others on the Internet
- Providing media to inspire transaction and facilitate comprehension
- Using real-world professional models to create relevancy
- Creating writing prompts that encourage and facilitate student ideas
- Providing easily accessed writing resources to foster good writing habits
- Finding ways to turn the computer off and apply the knowledge to authentic tasks
- Using technology to supplement the teaching of skills

Today's students are not the same as those of a decade or even five years ago: their relationship with computers and technology is one of comfort and familiarity. They understand, much more intuitively than we, that technology will be a key factor in their success. As teachers and leaders, we too need to embrace technology by utilizing it in an intelligent, relevant way, thereby sending the message to students that we recognize and are addressing changes in the world.

Teaching on the Internet: Creating a Collaborative Project

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Key Words: telecommunications, collaborative projects, project moderators, listservs

As more teachers become comfortable with listservs and Web navigation, an increasing number of collaborative projects are being posted on the Internet. However, some teachers need projects more specifically tailored to their own curricula and their students' needs. Teachers can easily post a request for collaboration in many different places on the Web. However, successfully creating and hosting your own Internet project requires more than just posting the request for collaboration.

This session outlines the steps for creating the project, posting the call for participation, and moderating the project. These steps were created as a result of my four years experience moderating the Through Our Eyes project (TOE) on the KIDLINK listserv (www.kidlink.org/KIDPROJ/eyes99). After a first year which met with limited success, I revised the project and examined the elements required for successful collaboration on the Internet. These steps, which are the focus of this session, are also outlined in the article "Teaching on the Internet, Creating a Collaborative Project," which is the feature article in the November 1997 issue of *Learning and Leading With Technology (L&L)* by ISTE.

Through the years, the TOE project has involved 119 classes from 19 countries and 25 U.S. states. This session will present the Through Our Eyes project as a model for collaborative projects. Then it will proceed to outline the necessary steps for collaboration: Preparation (purpose, objectives, activities, timeline, products, Internet issues), Registration Form, Posting (listservs and Web sites), Introduction (acknowledge registrations, post participants, introduce students, provide a forum for sharing), Instructing (small tasks, weekly contacts, due dates), Monitoring (sharing of tasks, Web pages, feedback), Sharing (certificates, graphics, hard copies, Web pages), and Evaluating (questionnaires). During the session, a multimedia presentation will show pages from Through Our Eyes on the Internet as well as an outline of the steps for moderating. Handouts will list Internet sites for posting projects and outline the steps for moderating projects. A copy of the article "Teaching on the Internet" from *L&L* will also be distributed.

Integrating Technology into Bilingual/ESL and School-to-Career Curriculum

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Key Words: **bilingual, ESL, school-to-career, staff development, collaboration**

An innovative program was designed through the collaboration of three departments at Boston Public Schools: the Bilingual Department, the Office of Instructional Technology, and the School-to-Career Office. The focus of the project was to bring together Bilingual and ESL teachers and expose them to current technology. The project's central focus was to provide Bilingual/ESL teachers with professional development while also building a collaborative team. Upon successful completion of the weeklong summer institute, each teacher received a computer and printer for their participation.

There was an overwhelming response to the application process, which was developed by the three collaborating departments. Even though the commitment to the project demanded a full week of attendance during summer vacation, the waiting list was in the double digits. During these daily workshops, teachers had instruction in Windows 95, Microsoft Word, Excel, and PowerPoint. Software and Web sites in a variety of languages were introduced. The teachers had an opportunity to work together and share ideas, skills and challenges.

A special breakout session was included, "School-to-Career Technology Solutions for LEP Students." High school Bilingual and ESL teachers surfed the Internet for Web sites, resources, and classified ads for jobs in target languages. Additional breakout sessions covered elementary software for early literacy and language development. Software was provided and teachers received hands-on experience previewing and evaluating the applications.

At the conclusion of the institute, each of the 20 participants was given a new computer (loaded with the productivity software used during the training) and a printer for their classroom. Follow-up support sessions were scheduled throughout the school year for the participants. The evaluations completed by the teachers reflected their appreciation for being included as bilingual educators in mainstream technology initiatives and receiving the educational tools to better serve their student populations.

The lines separating traditionally distinct departments were gradually dissolved with the blending of resources. We took an innovative step toward our Superintendent's (Tom Payzant) goal of "integrating technology seamlessly across the curriculum."

General Session: Curriculum and Instructional Strategies

The Electronic Educational Village (EEV): Building a Learning Community

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Key Words: learning community, online collaborations, interdisciplinary projects, online communication

The Electronic Educational Village (EEV) can be found online (www.liunet.edu/~edt/liteam/) and in-person through the year in locations and at events reaching from the eastern tip of Long Island to Queens in New York City and out into our global community. Participation is open to anyone committed to building a learning community with interest in learning systems and a willingness to model actions linking cultural and community resource partners, businesses, industries, children, and adults. Online participation joins learners in more than 25 school districts who converse in our village forums and collaborate on interactive Web activities with one another and our cultural and community partners. Actions stretch across disciplines, ages, and cultures.

The village began in 1991 with an in-person Kick-Off for teachers and cultural and community resource people, a year of text-only bulletin board conversations on local history, and a culminating event on campus for 500 fourth graders and their cultural and community resource partners. Now, eight years later, in addition to the Kick-Off event, a complex and dynamic Web site, and a culminating event, we hold more than 25 in-person sessions throughout the year to connect with our partners and to support our technology users.

Faculty, teachers, and community resource partners, this year, in the village, will describe what this learning community is and what it is becoming. Our presentation will include:

- A discussion and demonstration of how assumptions, beliefs, and the construction of what drives the village can be created by diverse partners. Focusing on critical thinking, creativity, leadership, and learning that gives to the community, each learner and learning action impacts the village. We will discuss the potential of combining in-person with electronic learning to transform the whole. We will discuss learner-centered, constructivist approaches to village actions appreciating individual learning styles and multiple intelligences.

- A demonstration of our communications tools, including multiple online conferencing systems (e.g., bulletin boards), chats, and interactive online input tools (e.g., registration online, survey tools, reaction and commentary collection boxes).
- A demonstration and discussion of 1998–1999 yearlong activities. Of the many collaborations, two will be shown. These may include the Expressioning Center and our Cultural Collaborations, both integral to the village this year. The Expressioning Center begins to create virtual and real places where collaborations on expressions in writing, art, music, photography, movement are nurtured, critiqued, and communicated. Our Cultural Collaborations celebrate diversity.
- A discussion of leadership in the village in a complex system of developing leadership embedded in a learning community.
- A discussion of K–12 interests, concerns and technology/learning plans for the future as joint ventures with the village.
- A description of our ninth on-campus culminating event scheduled for May 18, 1999.

Following our more formal presentation, we will work with session attendees to see how to participate in this "building of a learning community" or create their own.

General Session: Curriculum and Instructional Strategies

Web Research on Real Issues: Critical Thinking and Technology ... Really!

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Key Words: **Internet, Web, distance learning, electronic study strategies**

In May of this year, the government of India conducted five underground nuclear tests. What repercussions did these tests have around the world? The topic of this year's Critical Issues forum is Nuclear Non-Proliferation. High school students and their teachers in California, New Jersey, New Mexico, and other states will be studying these issues as part of a program sponsored by the U.S. Department of Energy, the Lawrence Livermore National Laboratory, the Los Alamos National Laboratory, and the Monterey Institute of International Studies.

This presentation will describe the Internet-mediated activities that support this program:

- Web-delivered curricular activities and supporting resources
- Telecommunications with experts in the science and politics of non-proliferation
- Exemplary electronic strategies for doing research on the Web
- Electronic strategies for synthesis, analysis, and reporting of information

In addition to the project description, there will be comments from past participants in the program.

Since 1984, Dr. Stephen C. Sesko has been developing and directing educational programs for educators, students, and technical personnel at the Science Education Center and for the Education Program of the Lawrence Livermore National Laboratory in the areas of computer programming, hypertext, telecommunications, and interactive learning environments. From 1994 to 1995, he led planning, development, and evaluation for science and technology projects administered by the Education Program of the Laboratory. Since 1995, he has led informal education projects involving science and technology for the Education Program and has led research projects in informal science. Sesko serves on the editorial review boards for major educational journals and conferences, and he is affiliated with several professional educational organizations. He maintains research interests in computers in education, education of the gifted and talented, theory and philosophy of learning, theory and philosophy of knowledge, curriculum and instruction, and issues in cognitive science. Sesko's most recent papers were delivered at the annual meeting of the American Educational Research Association and at the conference of the American Institute of Graphic Arts.

This project is not now, nor will it be a commercial product or venture, though it does make use of a software product that is on the market. The Science Technology Education Program (STEP) is an educational outreach program of the Lawrence Livermore National Laboratory. The Laboratory is managed by the University of California, under contract to the United States Department of Energy.

General Session: Curriculum and Instructional Strategies

Hard Copy to Hard Drive ... Nothing but the Truth

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Key Words: **literature-technology connection, active learning, communication skills, multimedia presentations, language arts literacy, collaborative planning**

The ability to collaborate and communicate effectively through the use of technology will be primary skills of the 21st century. "Hard Copy to Hard Drive ... Nothing But the Truth" is a powerful technology rich project that fosters the development of language arts literacy. This literature-technology connection leads students to identify, analyze and display the universal themes of a literary work as well as those themes specific to a novel under study; to learn how to plan and conduct research on the Internet relevant to developing a deeper understanding of the background and theme; and to learn how to use the computer as an aid to analysis. This month long project involves two phases. During the first phase, students independently read a selected novel (i.e., Nothing but the Truth), investigate related Web sites, produce storyboards and concept maps, receive instructional sessions on relevant software programs, and learn how to use computer presentation devices to convey to an audience of peers and wider school community what has been learned. During the second phase, students work in self-directed cooperative teams, incorporating their understanding of the novel, its plot, characters, setting, author's purpose and style, and the use of literary elements into technology-based products. The public relations team is required to develop a marketing campaign; the literary critics team, a book review; the educational publishers team, a Teacher's Guide; the film editors team, a multimedia slide show; and the playwrights team, a script based on the novel. Within this second phase, both individual students and teams develop problem solving and negotiating skills. All teams are given the opportunity to present their products through state-of-the-art technology.

Topics include:

- How technology and collaborative learning provide a prototype for creative teaching and active learning
- How students use concept-webbing software to organize their thinking
- How students represent important events in literature through multimedia presentations
- How teachers and technology staff collaboratively develop effective teaching strategies
- How textual and nontextual published products aid in the synthesizing of major themes in a novel

- How a classroom or computer lab can be turned into a mini production studio
- How this project addresses New Jersey's Language Arts Literacy Standards

Research Paper: Curriculum and Instructional Strategies

Students Learning Mathematics through Computer-Aided Presentations

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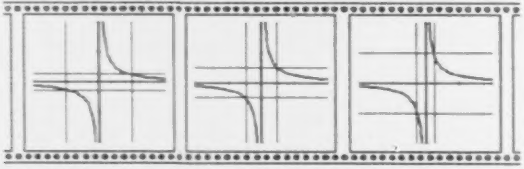
Key Words: **animations, presentations, research, students, calculus**

Animations

Funded by Borough of Manhattan Community College's (BMCC's) National Science Foundation (NSF) Small Experimental Project for Gender Equity, grant HRD 9710273, *Portfolios to Increase the Number of Women in Mathematics*, one of our most exciting women's research projects, was a computer animation of the ε–δ definition of the limit of a function. When Ms. Niang, one of our original NSF women's grant research fellows, presented her Calculus III project to an honors committee in December 1998, the mathematics teachers present felt her animations would make Cauchy's definition more accessible to beginning calculus classes. Ms. Niang is now putting her animation into a classroom type format for student use.

Cauchy's ε–δ Definition of Limits



For 1/x near 0, as δ decreases, ε increases. Thus, there is no limit at 0.

Ms. Niang was a biology major. She intended to end her mathematics after Calculus I, but now, after her A grade in Calculus III, is committed to a joint mathematics-biology major.

The success of our NSF students was endorsed when Borough of Manhattan Community College received a 1998 Mathematical Association of America (MAA) Tensor grant to leverage the NSF funding and expand the research fellowships for women.

Presentations

BMCC's women's grant has shown that one of the best ways to attract and retain students to the field is to get them involved in a research project under the direction of a competent mentor. The research projects involve more than study. Students are taught that a proper presentation of results, both written and oral, is a major component of research. When an outside evaluator of our mathematics courses asked to visit the calculus lab, one of our students, Ms. Seifullah, was working on an animation project in polar coordinates. By using the software MAPLE, a computer algebra system, she was creating moving images on the screen that showed how the graph changed as she changed variables in her equations. She is an NSF Alliance for Minority Participation (AMP) research fellow and this was her culminating project. The evaluator asked her to explain what she was doing and was amazed by her response. She said "What level of explanation do you want? Should I start by explaining what polar coordinates are? Do you want to know about the software that allows me to graph my equations? Would you like to know about the program I wrote, that allows me to animate my equations? Do you want to hear what I am concluding based on my animations?" Her grasp of the various levels of knowledge and skills she was using and her articulateness in explaining what she was doing made it clear she was functioning as a working mathematician. She is typical of many students in the program—they are not just "learning" mathematics, they are "doing" mathematics, which is what a working mathematician does. Her articulateness was honed by making presentations at the MAA metropolitan area conference, and her presentation, "Animation of Polar Functions," at the 1997 National Science Foundation—Alliance for Minority Participation Student Research Conference in Arizona resulted in an invitation to speak at a National Aeronautics and Space Administration conference.

Making computer presentations at professional conferences allow students to increase their grasp of the various levels of knowledge and skills in mathematical research and their articulateness in explaining their projects. Currently, BMCC students produce animated movies as part of their assessment in calculus, and in their AMPS and Mathematical Association of America—Tensor Foundation Women's research fellowships. Software, (e.g., Maple, and recently the TI-92 calculator) allows students to animate their sets of graphs of functions to produce mathematics movies. This project originated at BMCC. When our students started presenting their mathematics movies at conferences in 1993, there were no other animated presentations. Even today, there is at most one other presentation on animations. Attributes that students develop from successful presentations include:

1. making a clear, concise, written presentation of their research,

2. creating an effective graphical display,
3. animating graphs beyond a static display, and
4. explaining the mathematical research necessary to their projects.

Setting

Borough of Manhattan Community College, an urban non-residential college in the shadow of the World Trade Center in lower Manhattan, and one of the largest producers of associate degrees for African American and Latino students in the country, is in the midst of a long range program of institutional reform in all disciplines, but particularly in the exact sciences. Two-thirds of our students are women, most of whom are single-parents, women of color, and almost all of whom are financially-needy. We have received 4 MSIP and 10 NSF grants since 1988. Our successful calculus program has as a major feature of having students create a product in collaborative groups. These products are substantial academic projects that can be shown to a prospective college admissions committee or employer. Our course emphasizes students working in groups and using computer graphers and computer algebra systems to create written and animated projects. The projects' value was clearly shown when one of our African American female students interviewed at a local Ivy League University. The first reaction was that she had a community college calculus course, and thus probably needed remediation. She then showed her set of calculus projects developed through our program. Other professors were called in to look at her work. She ended the interview with a scholarship. Our project produces students capable of this high level of calculus performance. Our program has improved success and retention for women and minorities in calculus for BMCC's population which is two-thirds women, and 85 percent African American and Latino. We have been highly successful in attracting and retaining increased numbers of women and minority students into our pre-calculus and calculus sequence. Our enrollment in Calculus III, our highest level calculus course, has increased from 7 students in the Fall 1989 semester to 65 students in the Spring 1999 semester. In the first semester in which we introduced collaborative computer calculus projects, our passing rate went from 58 to 72 percent.

We have instituted a two-hour computer laboratory in all our calculus sequence courses. In our laboratory, students work in groups and use computer graphers and computer algebra systems to create written projects. The final result is an individual portfolio of the student's work. A portfolio is more than a collection of projects. It requires careful selection, evaluation, and insight into concepts. Each student in our calculus classes submits an individual portfolio by selecting his/her favorite three collaborative projects, and writing an essay stating the reason for selecting the particular projects, the educational worth of the projects, and the value of the computer in completing each project. The essay, together with the projects, constitutes the student's portfolio. Examinations, lab reports, and the portfolio are integrated into the final grade, taking advantage of multiple sources of assessment, as recommended in the AMATYC and NCTM standards. Macintosh software allows student portfolios to look extremely professional. Our experience verifies David Smith's results at Duke University. *When students are capable of more professional looking output, they spend more time making the content equally professional.*

The calculus laboratories are run by a laboratory technician who introduces the students to the software, and supports them with their projects. All projects are designed by the faculty with input from the laboratory technicians. In some cases, students have made important contributions to the design of the projects. Thus, even students of less computer supportive faculty benefit from this program. This is an extremely cost efficient approach to laboratory staffing.

Research

Uri Treisman states that an important part of mathematics education is the opportunity for the student to try on the persona of a mathematician. Research is a key part of this persona. Borough of Manhattan Community College has been able to provide our students with such successful research projects. Donald Stennett's research, "Animations of Series Approximations of Trigonometric Functions," won First Place at the 4th Annual National Science Foundation—Alliance for Minority Participation (AMP) Student Research Conference, "Education and Research: Parallel Paths to Excellence" in Tallahassee, Florida, on July 22, 1996. This improved upon John Romo's Honorable Mention for his *Light Helicopter* project at the 3rd Annual Student Research Conference.

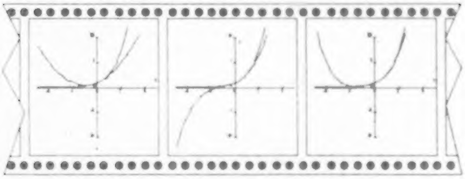
Our BMCC Mathematics Animation Program won a national award; First Place, "Student Created Computer Calculus Movies," *Student Success Strategies, Applying Technology to Teaching and Learning*, National Council of Instructional Administrators, American Association of Community Colleges, Minneapolis, Minnesota, April 1995.

Research is an important aspect of the Borough of Manhattan Community College calculus program. More than 20 students have received research fellowships from the Alliance for Minority Participation. Borough of Manhattan Community College students combine the two strategies of computers and collaboration in doing research within their calculus portfolios. In a serendipitous use of computers, our students' animations have produced research opportunities. Software (e.g., Macromind Director, Maple, and now the TI-92 calculator) allow students to animate their sets of graphs to produce mathematics movies.

Not only do students get to better visualize functions and series when these mathematical expressions are animated, but they are continuously introduced to the unpredicted. For example, a student animation of Taylor series showed some unexpected mathematical principles. The Taylor series creates a polynomial that approximates a more complex function. When the animation is shown, the polynomial appears to approach the complex function as we increase the number of terms of polynomial. For the sine function, an interesting effect occurs at the ends of the graph. As the number of terms increase, the polynomial graph alternated above and below the sine function. The effect was that of wagging tails. For the polynomial expansion of e^x, the tail wagged on the left side only.

The issue of the wagging tails is a mathematical problem that becomes interesting through this technology and has offered students a nice opportunity to investigate what was happening.

Animation of MacLaurin Series of e^x.



The tail wags on the left side only.

Conclusion

BMCC is part of the largest urban university in the country, with a student population that is predominantly African American, Latino, and largely female. This student research and presentation mathematics project has already had a significant effect in expanding the numbers of under-represented women and minority students in mathematics. The project has also had a significant effect on students whose articulateness has been honed by making presentations, and on faculty in increasing our volunteer mentors. It unites efforts already funded by NSF with more recent technological innovations. The project has, in short, purpose, passion, promise.

General Session: Using Technology to Facilitate Learning

Letting Go: Teachers, Students, and Technology in the New Millennium

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Key Words: **integrating technology, project-based learning, ThinkQuest, Internet**

You want to integrate the Internet and computers into your teaching and your classroom. You know how motivating technology can be to students. You understand the potential of student directed, inquiry, collaborative, project-based learning. You want your students to explore large content-based questions and you want to break out of that old 'instructor' role. But the challenge seems so big and the risks so large. How do you keep control when your students are Internet Magicians and you get dizzy just trying to understand what they are talking about, let alone where they are going online? It's just too much!

These are serious questions for all educators. How do teachers navigate this uncharted territory and harness the interest and motivation technology brings to students without being overwhelmed or totally losing control? In this session we will hear the lessons of educators who have explored the realm of Internet assisted, student directed, project-based learning as coaches in the ThinkQuest and ThinkQuest Junior programs. They will speak of the process and demonstrate the results of giving students control of their own learning. An overview of the ThinkQuest initiative will be presented and examples of student produced educational Web sites created for ThinkQuest competitions will be demonstrated.

General Session: Curriculum and Instructional Strategies

Collaborative Projects that Support NETS Standards for Young Children

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Key Words: collaborative projects, NETS, standards, Internet, lower primary grades

The purpose of this session is to provide classroom teachers, administrators, and technology coordinators with concrete advice on how to address the NETS standards in the lower primary grades through the use of Internet collaborative projects. The presentation draws upon my personal experience in hosting several successful online projects and my 28 years as an elementary classroom teacher, to offer real-world guidance and strategies for successful integration of NETS standards in the classroom.

Learning standards provide a framework for selecting, focusing, and talking about curriculum. ISTE has done an excellent job in formulating the National Educational Technology Standards (NETS). As educators, we are faced with the multiple challenges of (a) providing our students with a motivating, challenging classroom environment, (b) addressing state and national standards, and (c) ensuring that our educational approach allows all students, regardless of capability or interest, to thrive and succeed.

Online collaborative projects have become one of the key vehicles which educators may use to respond to these challenges. Collaborative projects take many forms, from simple e-mail information exchange to longer-term thematic research projects. This presentation will describe the major categories of collaborative project, identify the specific NETS standards addressed by the different project types, and illustrate examples of each variety.

We will explore three different types of collaborative projects:

- Interpersonal Exchange,
- Collaborative Research, and
- Thematic Showcase.

Interpersonal Exchange projects can be as simple as writing e-mail to students from different schools, or trading travel buddies. These projects are a wonderful way to teach geography, word-processing skills, and online communication skills. An Interpersonal Exchange project requires very little technology resource, and is perfect for the teacher who is new to online collaboration.

The next project category, Collaborative Research, involves collecting data, sharing information, and presenting results. These projects tend to have a stronger emphasis on mathematical and scientific skills. We will explore "Stellaluna's Friends," a research project on bats which I coordinated last spring. By placing research into a national or global context, collaborative research projects not only illustrate the differences between natural phenomena in different regions of the globe, but also the surprising similarities between children's experiences globally. Many NETS standards and performance indicators are facilitated through these types of projects.

The third and final category, Thematic Showcase, has a creative and literary emphasis. During the fall of 1998, we hosted a thematic project, "Pumpkin Patch," that showcases poetry and graphics from young children throughout the United States, South Africa, and Canada. This project was specifically designed to support New York State and NETS standards.

The next part of my presentation will identify the key elements of a successful collaborative project. There are many projects to choose from and selecting a project can be a bit overwhelming. I will offer the attendees some pointers based on my experience. We will talk about where to find projects and how to enroll as a participant.

Hosting an online collaborating project requires a significant time commitment, but with advance planning the effort does not have to be unmanageable. Pick a topic that you are familiar with, one that appeals to your students' age group and that is broad enough to tie in to many curriculum areas. Be sure to have well defined objectives, a deadline, and make yourself accessible for questions. Give your participants enough time to organize their project and stay in touch with them. Don't accept more participants then you think you can handle, and don't overextend your technical abilities. Be open to suggestions and ask for feedback to use on your next project. But most important, just try it and have fun!

The session handouts include URLs of the project resources discussed during the presentation. Participants will leave this session with all the tools needed to integrate online collaboration into their classroom curriculum and will understand how these projects support NETS standards.

Managing Copyright in Schools

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Key Words: **copyright, fair use, ethics, legal issues**

Copyright is a quagmire. Like most laws, federal and state, repeated revisions have made simple reading and interpretation difficult. Beyond the laws, there are copyright guidelines that interpret the statutes and give guidance and confusion in equal measure. These mandates require that we both understand and manage the tangle that is copyright.

The following media have copyright management issues worthy of discussion:

- print
- images
- video (created, purchased, and off-air)
- audio (including music)
- computer software
- audio-visual hardware
- LAN resources
- Internet

All have implications depending on the location and type of use, and the nature of the application. Dealing with the human factor will be the largest problem of copyright compliance.

The new multimedia guidelines require that all multimedia presentations using copyrighted materials adhere to a set of recommendations that include opening screens which notify of copyright protected content, and credit pages listing complete copyright ownership information for each item used under the fair use exemption. This applies to students as well as teachers.

Teachers may prove to be the copyright compliance project's toughest case. For many years, the teacher has been able to use, without challenge, whatever materials s/he felt necessary or convenient. Abuses were common, leading to the myth of the "Friday movie," among others. When someone points out that such uses are not fair and could bring legal repercussions on the individual or school, that comfortable status quo is rocked. There are several techniques of explaining copyright expectations to faculty, as well as tracking and management techniques.

Support staff knowledge of copyright is probably minimal at best. Most of staff involvement with copyrighted material will be via photocopying. With the support of the administration, training the clerical staff on copyright of print material will likely be sufficient to raise awareness of what can and should be copied.

Few administrator training programs mention copyright law in the school law class, and those that do usually gloss over the specifics. When approached, administrators are likely to protest that they haven't heard of any schools who have been cited for copyright abuse, so why bother? Copyright infringement actions do happen to school districts. There are several methods of ensuring compliance that may be applied through administrative management at the district and building levels.

It is possible to manage and monitor copyright and still retain a collegial atmosphere. Place the emphasis on ethical and citizenship responsibilities. Since copyright law is a federal statute, educating students and teachers on their requirements under those laws is more than just a protection for the school—it's an obligation to teach and model ethical and law-abiding conduct. Copyright compliance is not a minor inconvenience, but it is an opportunity to demonstrate our support of the national ideals of governance under law.

General Session: Curriculum and Instructional Strategies

Tools Not Toys: Infusing Computer Skills into the Regular Curriculum

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Key Words: **middle school, science, curriculum, computer skills, infusing, integrating**

Computers in the workplace (the real world) are tools used to enhance and simplify the work that needs to be done. Classroom computer use, however, often merely adds activities onto an already crammed curriculum as a way of including the newly available technology. Or, vice versa, computer activities are often created for the purpose of teaching particular computer skills without real relevance to other student learning.

This workshop will demonstrate how teachers can use basic computer skill applications to improve upon classroom projects that are already known to be effective. (Applications will include word processing, spreadsheet-making, drawing, and painting.)

Student-done examples of activities taken from a middle school level science class will be used as models. The student work will include illustrated writing, graphs, and charts created in classroom experiments and technical drawing. Computer directions for selected activities will be available.

General Session: Computer Science

Student Experiences Using C++

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Key Words: **programming, C++, students**

C++ is the programwming language that high schools have been encouraged to begin teaching. In response to this, Horace Mann added a course in C++ to the Computer Science curriculum three years ago. By the 1998-1999 school year, all computer science courses were taught with C++. Student response has been positive and enthusiastic.

This session will focus on student perceptions of computer science courses and C++ in particular. A team of students from the first year course through the Advanced Placement course will present and be prepared to discuss their life and times as a part of the Computer Science program at Horace Mann. Anticipated presentations and discussions include: being the first group to take the AP exam in C++, favorite Web sites and book resources, writing Windows programs, Java vs. C++, and being a female student in a technology course.

Attendees of this session will have the opportunity to learn what works and what does not work from the perspective of students enrolled in high school computer science courses. Attendees can anticipate viewing many examples of student work and hearing candid student responses to various programming assignments.

Inquiring Minds Want to Know: Creating a Colonial American E-Zine

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Key Words: **Web pages, middle school, electronic magazine, Internet, English, history, interdisciplinary**

This is a successfully tested interdisciplinary, technologically-based, research project about Colonial America. It was developed as part of ICAT 98, a Washington state grant awarded to our school district.

At a time when more and more curricular demands are made on our already stretched instructional time, it was important to combine as many aspects of our curriculum as possible with Washington state's new state Essential Academic Learning Requirements, technological innovations and School-to-Career expectations.

Although this project was based upon Colonial America, it is very adaptable: with simple modifications, any teacher of any subject area and/or grade level could assign their own list of topics to implement a project just like this one. Participants will receive comprehensive handouts and a computer disk that include how this project was implemented from start to finish. Student examples (via Web site), directions on how to implement this activity, student handouts, and forms for the educator's use will be included.

Topics discussed will include information on the entire unit from start to finish:

- Setting up your publishing company: positions available, job descriptions, and creating a positive work climate
- Approaching the project with a School-to-Career approach: from job applications and resumes to the interview process and hiring

- The research and writing processes
- Turning the research paper into a Web page using Claris Home Page 3.0
- Hooking the whole thing together

General Session: Social and Ethical Issues

Link-to-Learn: Models for Reaching the Hard-to-Reach

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Key Words: **Internet, training, access, aging, social services, literacy, community development**

Five recipients of Pennsylvania Department of Education Link-to-Learn grants describe their projects' successes in expanding access to the Internet and its resources for a variety of hard-to-reach populations, both rural and urban. Projects showcased employ diverse technologies, from videoconferencing to mobile technology vans, to provide diverse populations, from inner-city senior citizens to rural elementary students, with diverse resources, from job training to health education. Each project offers a unique approach to bringing together many segments of a community education, nonprofit, and corporate sectors to share resources and expertise for the benefit of all residents, especially its socially, economically, and geographically disadvantaged populations.

Enhancing Educational Experiences in an Urban Environment

Kutztown University, in partnership with the Reading School District and several community-based agencies, presents a successful model for the use of technology in enhancing, increasing, and maximizing learning opportunities in a highly transient, ethnically diverse student and adult population. Additionally, this model presents a successful paradigm for the use of two-way interactive videoconferencing in introducing preservice, student teaching, nursing, and social work students to the academic and social challenges of an urban community.

PEN: Making the Rural Connection in Elk and Cameron Counties

The Community Education Council is a small entity that has had a tremendous impact on two counties. Through the Pennsylvania Educational Network (PEN) Project, the Council is providing rural adults with access to computer and interactive television and training, as well as introducing industry, business, and local nonprofits to the benefits and competitive advantages made possible through the Internet and videoconferencing. The presentation describes how the Council's computer lab and videoconferencing facility has been used to provide affordable classes on the Internet and basic computer technology to more than 1,000 enrollees.

LincServ: Sharing Resources/Meeting Needs

Lincoln University's LincServ project provides a model for creative, collaborative, low-cost technology-based approaches to social problem solving. First year targeted populations include inner-city youth, staff and residents of senior citizen centers, and staff from a variety of human service agencies.

Next Step Network Extension

Next Step uses videoconferencing, Web-based, and CD-ROM technologies to extend educational opportunities and employment services to local residents. Components include a Virtual Learning Institute, interactive homework Web sites, and a Technology Literacy Camp for elementary students. This presentation provides a model for the creation of a technologically literate workforce supported by an environment in which a community of learners is fostered among all age groups and between a variety of social and educational institutions.

State Gerontology Education, Training, and Information

This project describes how the Geriatric Education Center of PA (a collaboration between Temple, Penn State, and the University of Pittsburgh) and the PA Health Care Association are addressing the many constraints to geriatric information dissemination by developing a CD-ROM on health issues for older adults, expanding the Geriatric Education Center, placing networked videoconferencing capacity computers at care sites in remote locations, and developing an online aging information search engine.

Wield the Web: An Internet Skills Curriculum

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Key Words: **staff development, Internet, curriculum, Dimensions of Learning**

Wield the Web is an Internet skills curriculum. It trains teachers, elementary students, and secondary students in how to use a browser, how to use a search engine, and how to evaluate a Web site. It is structured on Dimensions of Learning, a cognitive framework for best practices in teaching and learning.

There are five Dimensions of Learning. Dimension 1, Attitudes and Perceptions about Learning, asserts that unless a student is comfortable in the classroom and sees the value of classroom tasks, she will not work to her capacity. Wield the Web addresses Dimension 1 by summarizing why students should want to learn to use the World Wide Web.

Dimension 2 is Acquiring and Integrating Knowledge. Here the student internalizes the procedures and factual knowledge he needs. This project teaches the basics of browsers, search engines, and site evaluation as its procedural knowledge. Workshop attendees will receive copies of handouts for learning these skills for themselves, and for teaching them to their students.

Dimension 3, Extending and Refining Knowledge, and Dimension 4, Using Knowledge Meaningfully, are the core of the Dimensions model. Here students engage in meaningful learning tasks that challenge them to construct their own knowledge. Wield the Web contains model lesson plans that include: the unit of study, the specific learning task, relevant Web sites, and descriptions of how the lesson could fit into the unit of study.

These lessons are based on two beliefs. The first is that the Internet, while a revolutionary tool, is still just a tool for learning, and not a learning end itself. The second is that teachers should not attach a separate "Web unit" onto their curriculum, but instead should integrate use of the Web into their existing content-rich lessons.

Dimension 5, Habits of Mind, articulates thinking skills that promote lifelong learning. These skills often run contrary to natural human tendencies, so they must be explicitly taught. Wield the Web focuses on the habits that using the Internet can promote, such as: planning; being aware of resources; open-mindedness and taking a position; engaging intensely in tasks; and pushing the limits of your knowledge. Wield the Web asserts that while the Internet is another tool in the effective learner's toolbox, it is a radically powerful tool, able to reshape ways learning occurs. Teachers and students well-trained in Web basics can wield its power to learn more effectively.

Teachers will leave this session ready to master use of the Web for professional growth as well as to enrich their students' learning. They will know how to promote the critical thinking skills of their students as they search for information in their classroom, and how to use the Web to provide their students with skills they can carry with them when they've left that classroom.

Robert Stocking, Jr., combines eight years of social studies teaching experience with five years as a middle school technology specialist, training teachers in the integration of technology into their teaching and professional work. He won a Christa McAuliffe Fellowship to create this project. Stephanie Hebdon is a national board-certified teacher with over 20 years' elementary classroom experience and three years' work as a technology specialist.

General Session: Staff Development

Utah Technology Awareness Project—Web-Based Technology Assessment Tool

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Key Words: staff development, technology assessment, training, teacher evaluation

Have you ever attended a technology staff development workshop that was either over your head or so basic that you came away not learning anything? What about when you've provided technology training for teachers. Have you ever gone into a workshop not knowing the skill level of those you are teaching? Have you ever wondered if the students learned anything from the workshop? These are all common problems with current technology training workshops. A tool has been developed to help overcome these and other training issues.

The partnership of Southwest Educational Development Center, Utah State Office of Education, Utah State University, Southern Utah University, Brigham Young University, WestEd, and UtahLINK have teamed up to develop the Utah Technology Awareness Project (UTAP) to aid in providing more meaningful and productive technology workshops for educators. UTAP is a Web-based technology self-assessment tool for educators, located at www.uen.org/utap. (Please login as "guest" and try it out.) Working together, we developed four-level rubrics that describe the competencies in six categories: Basic Concepts, Personal and Professional Productivity, Communication/Information Skills, Classroom Instruction/Management Skills, Educational Leadership, and Technical Troubleshooting. From the rubrics, online questions were devised that (1) help teachers measure their current competencies, (2) show development possibilities across the rubric, (3) chart growth over time, and (4) match teacher needs to available training.

UTAP provides reporting for state, region, district, and school level. The report provides an overall vision of training needs for each level. Also, a report is generated for each teacher showing current skill level and associates available online and traditional training that meets the needs of the teacher.

Trainers enter class offerings online and correlate the class objectives with the levels of the rubrics. They can use UTAP to report the student's skill level before the class to determine class content. UTAP also offers feedback to trainers on student growth after the course is completed.

We will present how this idea came to be, how we developed the rubrics and the Web site, and how we are currently using the Utah Technology Awareness Project to further technology in Utah. We will demonstrate how teachers around the world can login to the Web site and use UTAP.

General Session: Curriculum and Instructional Strategies

National Educational Technology Standards (NETS): Unleashing the Power of Technology for Learning

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Key Words: **NETS, standards, performances, technology, literacy, accreditation**

Technology is a powerful tool with enormous potential for paving high-speed highways from our out-dated educational system to a system capable of providing learning opportunities for all children—one that will better serve the needs of 21st century work, communications, learning, and life. The International Society for Technology in Education (ISTE) and the public at-large recognizes the potential of technology to change education—to improve student learning—to become a powerful catalyst in promoting the learning, communications, and life skills for economic survival in today's world. Through its NETS Project, ISTE is encouraging educational leaders to provide learning opportunities that produce technology capable students.

Within a sound educational setting, technology can enable students to become:

- Capable information technology users
- Information seekers, analyzers, and evaluators
- Problem solvers and decision-makers
- Creative and effective users of productivity tools
- Communicators, collaborators, publishers, and producers
- Informed, responsible, and contributing citizens (ISTE, National Educational Technology Standards for Students, 1998)

Societal change historically produces widespread change in education. There are initial indications that unleashing the power of technology for learning, information exchange, and communications has the potential to affect powerful changes in how teachers facilitate learning, how students contribute to the learning process, how knowledge is demonstrated, and even the venues in which learning takes place. A major challenge for educational leaders is to map a course that takes advantage of this power to improve learning. It is critical that we begin to reshape our educational system to take advantage of the available technologies that are rapidly becoming integral to success in our information-oriented society. Used appropriately, these will smooth the road of change.

The standards movement in education strives to provide national consensus on what students should know in content subjects. But the use of technology as powerful tools for applying content knowledge has not been addressed adequately within the movement. "Knowing" is not a sufficient end in itself—application of knowledge to construct new understandings, solve problems, make decisions, develop products, and communicate knowledge is essential for every student's education. The ISTE NETS Project is committed to formulating a national consensus on the role of technology in schools and identifying the supporting conditions necessary to ensure that the potential gains from the use of educational technology are achieved. The ISTE NETS standards development process will result in the following standards documents:

- *Technology Foundation Standards for Students*, describing what students should know about technology and be able to do with technology (available at www.iste.org/)
- *Standards for Using Technology in Learning and Teaching*, describing how technology should be used throughout the curriculum for teaching, learning, and instructional management (new release)
- *Educational Technology Support Standards*, describing systems, access, staff development, and support services essential to support effective use of technology (in progress)
- *Standards for Student Assessment and Evaluation of Technology Use*, describing means of assessing student progress and evaluating the use of technology in learning and teaching (in progress) (ISTE, NETS for Students, 1998)

The comprehensive ISTE NETS Project will reveal the essential conditions necessary to unleash the power of technology to facilitate fundamental changes in the way students learn, the types of resources for learning available in classrooms, and the manner in which teachers facilitate and assess learning.

Enhancing the English Writing Skills of ESL Students Using E-Mail

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Key Words: ESL, writing skills, writing apprehension, e-mail, CMC, preservice teacher training

Providing ESL students with sufficient opportunities to write in a realistic setting and with adequate feedback is a problem in many ESL classes. Using e-mail as a communication vehicle to connect ESL students with writing mentors is one answer to this problem. A mentoring partnership between Middletown High School and Salve Regina University has been implemented for the past two years with great success. Preservice teachers, who are secondary education majors enrolled in a Reading in the Content Area class, are paired with ESL students at the high school.

A comparison of pre- and posttest scores has demonstrated statistically significant increases in writing ability and decreases in writing apprehension for the vast majority of participants. Preservice teachers stated that they gained experience in technology and multicultural education that would be difficult or impossible to obtain without such a field project.

Topics include:

- A comprehensive plan for replicating this project
- Samples of training materials
- Samples of student and mentor writings
- Suggestions for avoiding technical pitfalls
- Guidelines for recruiting suitable mentors
- Guidelines for pairing mentors with students

General Session: Curriculum and Instructional Strategies

Building Community—The Casino Connection

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Key Words: community, casino, Internet, lesson plans, Russia, staff development, training

Are you looking for exciting new ways to incorporate Web-based lessons into your curriculum? Do you envision a classroom where each child is on task continually? Visit the "Treasures of Russia" and see how Nevada teachers turned a cultural exhibit into a mecca of quality lesson plans and preserved many facets of a visiting exhibit for years to come.

In a quest to foster the building of community, InterAct™! and Technology Development Services joined with the Rio All-Suite Casino Resort in Las Vegas, Nevada, to promote a cultural and historical museum attraction in our city. The hotel, with sponsors such as the State Museum Reserve-Peterhof, in St. Petersburg, Russia, The Forbes Magazine collection, and La Vielle Russie, both in New York, hosted "The Treasures of Russia" exhibit, in Las Vegas, from November 7, 1998, through April 15, 1999. The display spanned more than 200 years of Russian history, from Peter the Great to Nicholas II, and included items never before seen in the West, and many that had never been displayed in Russia. InterAct™! and Technology Development Services mirrored this event in a Web-based virtual gallery. Students and their teachers were able to visit the site online and access a wealth of educational material created for them. They were able to study the background, participate in related lesson plans, and contribute projects. The Clark County School District Partnership Office and the Clark County Public Education Foundation contributed funds to make this a free field trip for Grades 6 through 12.

Working with a cadre of local teachers to create this Web site and to develop a variety of standards-based, Web-based, interactive lesson plans, the CCSD was able to preserve facets of the exhibit and the cultural and historical background for the enjoyment of students for years to come. The lessons and the virtual gallery (www.ccsd.net/treasures/) remain a part of the CCSD educational program even though the exhibit has returned to Russia.

Topics include:

- The Clark County Public Education Foundation
- The Treasures of Russia
- Integrating technology
- Staff development
- Online communication
- Hands-on experience with the Treasures of Russia Virtual Gallery, related lessons, and background materials

General Session: Curriculum and Instructional Strategies

Technology Treasurers for the Elementary Classroom

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Key Words: **elementary, integration, lesson plans, multimedia, Kid Pix, AppleWorks, HyperStudio**

See and learn how to integrate the use of technology into your classroom curriculum. Attendees will view stimulating projects for the classroom using Kid Pix, HyperStudio, and ClarisWorks (now AppleWorks).

This session will demonstrate ways for classroom teachers to use technology as a tool to help them cover their curriculum. I will share with the participants several of the projects that the students at my school have successfully completed. These will include the use of three applications that are fairly universal among elementary schools: Kid Pix, HyperStudio, and AppleWorks. Sample lessons might include the following:

- Kid Pix: creating online and offline worksheets for beginning reading skills, number recognition, and counting; slide show for research projects and math applications; and language arts writing projects.
- HyperStudio: research projects combining science, language arts, and student drawings; stories written for and shared with younger students; and individual

student projects combined to create a larger one used for future lessons and research.

- AppleWorks: big book and small book creation; projects combining drawing, word processing, and spreadsheet within a single file; templates for worksheets and or tests; and using the slideshow for presentations.

There will be time at the end of the sessions for questions and sharing of ideas. I know that the teachers at my school have benefited from sharing our ideas and projects with each other, and I am sure that other educators could benefit as well.

General Session: Staff Development

Staff Development—The Total Solution: Administration, Training, Implementation

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Key Words: **staff development, training, workshops, classes, Internet, job descriptions**

The Orcutt Union School District has developed a support system and training model that underlies all levels of technology in the district. The Administration, Training, Integration Model begins with vision setting and district level support. The program is overseen by an actively involved Superintendent and led by the Associate Superintendent of Curriculum and Instruction, and the Program Manager of Technical Service. The district provides planning, organization, and implementation of the plan with input from teacher committees. We have developed a wide range of in-house experts who provide a variety of training opportunities. This cadre has evolved over the past eight years, with district support, to include a Program Manager of Technical Services, a District Technology Mentor, a District Internet Specialist, and a District Network Manager. At each site we have a Systems Operator, a Technology Specialist, and an Internet Leader. There are also numbers of individuals in the district who have become Application Specialists on one or more specific pieces of software. All of these individuals form the core of the staff development cadre. Training runs the full range from beginning through advanced computer, courseware, productivity, digital, video, and audio applications, and troubleshooting. We have also implemented a senior citizen training program in conjunction with the local junior college.

Many training opportunities are offered to our entire staff (including classified personnel). Training includes such things as Tech Tuesdays—site-based weekly training opportunities, Curriculum Development Sessions—Web link and WebQuest plans, a School's-in-Conference, training for specialists, special application training, and the District Technology Training Program.

The focus of this training is the integration of technology use in instruction. Our students participate in Internet Clubs, WebQuest, technology-based projects, and use of technology in a variety of curricular areas. The "how?" and "why?" of the results of this integration will be shared.

In this session, attendees will learn how to develop their own training model based on the elements of the Administration, Training, Integration Model. As they view a well-defined PowerPoint presentation and listen to the presenters, they will learn how to develop low-cost district and site support positions, and how to establish training utilizing current staff. They will receive handouts that describe our various technology job descriptions, sample training flyers, Internet Club brochure, WebQuest sampler, and lesson plans. Attendees should leave with a complete picture of how a successfully integrated staff development program can be established. This 45-minute presentation will conclude with time for attendees to ask questions and probe deeper into points of interest.

Research Paper: Teacher Education and Training

Infusing Technology into a Teacher Education Course: Elementary Teachers' Mathematical Conceptions

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Key Words: **mathematical conceptions, technology, teacher education, microworlds**

This phenomenological study took place over a 16-week semester during which 12 elementary school teachers explored mathematical ideas for elementary school students while using computer microworlds. Four themes of learning on her own, authority and control, mathematics as manipulating, and frustration and confusion were manifested in the case study of one teacher. The second case study brought forth the two themes of learning with others, and authority and control. The study demonstrates how the teachers' experiences can provide insights for mathematics teacher educators about using microworlds and a variety of organizational styles to

create differentiated tasks that promote teachers' reflection when learning and teaching mathematics with technology.

The purpose of this paper is to present some of the findings of a phenomenological study which described and interpreted the experiences of two female elementary school teachers as they understood and ascribed meaning to their conceptions (i.e., knowledge, beliefs, attitudes, and emotions) of mathematics as a discipline, the teaching and learning of mathematics in their classrooms, and the teaching of mathematics with technology in the context of a technology-enriched mathematics teacher education course. Whereas there is widespread agreement that teachers are key change agents in bringing about reform in the teaching and learning of mathematics, including the teaching of mathematics with technology in their classrooms (Kaput, 1992; National Council of Teachers of Mathematics, 1991; Willis & Mehlinger; 1996), there is little research about the developmental process of teachers' learning in technology-enriched environments.

Addressing the problem of most teachers' lack of infusion of technology into reformed mathematics curricula and reformed teaching practices is important because many teachers who have not experienced mathematical learning in technology-enriched environments find it difficult to facilitate students' mathematical learning in such environments. According to the National Governors' Association (1991), "the most effective training is accomplished within the curricular area which the technology is to be used" (p. 37). Bull (1997) concurs that the "standards established by teachers and subject matter specialists in specific content areas may prove to be the most useful" for the integration of technology in teacher education programs (p. 338). A key issue that must be addressed for mathematics teacher educators or staff developers is how to design a professional development program which simultaneously challenges teachers' conceptions about the teaching and learning of mathematics, and provides opportunities for teachers to develop their confidence and competence in mathematical thinking and pedagogy while teaching with technology in their mathematics classes.

Theoretical Framework

Drawing on a blending of perspectives, I pulled together the intertwining strands of phenomenological, social constructivist, and affective perspectives. The strands are based on an interaction between Confrey's (1991) potential integration of Piaget's and Vygotsky's theories of cognitive, intellectual development and McLeod's (1992) theoretical constructs of affective development, plus a strengthening of the construct of attitude to include emotional intelligence. This resulted in a theoretical model that extended Myers' (1980) reciprocal model for interactions between learners' attitudes and behaviors.

Cobb (1994) calls for a coordination of constructivist and sociocultural perspectives in research about mathematics teaching and learning. Confrey (1992) discusses a new challenge for research concerning the role that technology plays in an individual's development of mathematical knowledge, and the viability of components taken from both Piagetian and Vygotskyian frameworks. Specifically, she raises the issue of "How ought we to view knowledge as it evolves in relation to our interactions with non-living objects and our interactions and interconnections with other human beings, and the interactions between these two types of interactions?" (Confrey, 1992, p. 44). It seems that both the types of interaction and the available tools of language and computers are crucial to a "co-shaping process" in which individual conceptions and social interactions contribute to cognitive development.

Important as the constructivist and sociocultural perspectives of teacher's learning might be, they seem to be incomplete. Using Mandler's cognitive approach to research on affect, McLeod (1992) proposes the reconceptualization of the affective domain in mathematics education to encompass not only attitudes but to include "beliefs, attitudes, and emotions as representing increasing levels of affective involvement, decreasing levels of cognitive involvement, increasing levels of intensity of response, and decreasing levels of response stability" (p. 579). Given the increased focus on high-level, conceptual understanding of mathematics recommended by current reform documents, a potential increase in the intensity of affective responses (e.g., emotions) to mathematics may result in promoting more positive or negative attitudes when compared to affective responses to mathematics while learning low-level, procedural understanding of mathematics. Within the context of the teaching of mathematics with technology, continued advancements in technological innovations may significantly change what mathematics is taught, and this may result in changing our beliefs about what is valuable in mathematics.

Participants and Analytical Technique

Making the choice to participate in professional development courses for a reformed vision of the teaching and learning of mathematics, which includes teaching mathematics with technology, is often accompanied by a sense of anticipation. Over the course of the semester, I studied the conceptions of three teachers, but for the purpose of this study I chose to focus on Robin and Susan. Robin's decision to enroll in this master's level mathematics teacher education course was motivated by her need for more "teacher training," her feelings of inadequacy towards understanding mathematics, and her desire to teach conceptually-oriented lessons involving manipulatives and mathematics software. At the time of the study, Robin was teaching a class of third graders for her second year in this school and had taught for seven years. Robin remembers experiencing the learning of mathematics as a subject that did not make sense to her as a child. Towards using technology, Robin describes that she likes working with computers (including the Internet) and learned to use them mostly on her own; she also enjoys spending many hours helping other people set up there computer systems.

Susan, the teacher in the second case study, explains that she enrolled in this course as part of her requirements for completing a master's degree in mathematics education. She describes the difficulty in finding courses that are "focused on the math and elementary together" and hopes for "a mix of ideas about theories of how kids learn and a set of practical, not lesson plans, but the idea of, what can I walk into my classroom and do." At the time of this course, Susan had taught for six years and was teaching a fourth grade class for her second year in this school. She remembers testing out of the required mathematics courses for elementary education majors and she enjoys taking mathematics courses. When teaching with technology, she uses computers for students' drill and practice in mathematics, exploring patterns and problem solving with calculators, word processing, and e-mail connections to participants in the Alaskan Iditarod race.

The primary goal of the course is centered on the teachers' exploration of mathematical knowledge within the domains of whole numbers and rational numbers through their use of Tools for Interactive Mathematical Activity [TIMA] (University of Georgia, 1994) computer microworlds and manipulatives. The TIMA microworlds developed from an analysis of the types of activities children employ in their construction of number sequences and fraction schemes (Biddlecomb, 1994; Olive, 1993; Steffe & Olive, 1990). In the Toys microworld, discrete objects or toys can be replicated on the screen, connected, and counted as individual or composite units. Counting is a universal activity in which the learner constructs schemes relating objects to number. In the Sticks microworld, continuous objects or sticks are constructed on the screen, segmented, or iterated into composite units. Using the Sticks microworld, children use measuring strategies such as comparing, ordering, and quantifying in constructing knowledge about fractions. Given the research (Olive, 1993; Steffe & Olive, 1990; Tzur, 1995) on the role children-computer interactions and teacher-student interactions play in children's development of whole number and fraction knowledge, the study presented adapts these findings for examining teachers' knowledge of whole numbers and fractions.

As a participant observer, I recorded field notes for all graduate class sessions and videotaped each class, with one camera recording large group activities and the second focusing on the case study teachers. I conducted case studies of three of the teachers, including four audiotaped interviews with each teacher, collection of reflective journals and final projects, a series of nine classroom observations of the teachers in their classrooms, and pre- and post-course attitude surveys for all 12 teachers. Tapes (audio and video) were transcribed and analyzed. Data were collected and analyzed following the inductive process of constant comparative analysis described by Glaser and Strauss (1967). The analysis process consisted of identifying emerging themes and relating these to literature on teachers' learning, conceptions, technology, and developing assertions.

Analysis

From the data analysis, the case study of Robin brought forth four themes: learning on her own, authority and control, mathematics as manipulating, and frustration and confusion. The case study of Susan manifested the themes of learning with others, and authority and control. As part of a larger study, only a selected part of Robin's and Susan's conceptions of learning and teaching mathematics with technology will be presented in this paper.

At the beginning of the study, both Robin and Susan described technology as machines or modern inventions that made peoples' lives "easier." They articulated that computer games were a fun way for students to practice basic mathematical skills. During the mathematics teacher education course, both women explored mathematical situations in which the TIMA microworlds were used regularly as tools to enhance their own and their students' mathematical learning. However, clear differences emerged in the teachers' experiences.

Doing mathematics with a computer is becoming involved with making sense of a partner's mathematical thinking through his or her actions and language while interacting with the computer; or, if working alone, only making sense of the learner's own thinking through his or her actions. Becoming familiar with mathematics while using a computer is about becoming part of both a community of mathematics learners and computer users who share values and expectations. For Robin, learning with a computer meant learning on your own and figuring things out by yourself. Characterizing herself as not being a "social learner" she held little commitment to collaborative work with her peers. In many instances, Robin's lack of conceptual knowledge of specific mathematical topics limited her ability to verbalize any mathematical understandings to the other teachers. Working alone, Robin was not obligated to understand her partner's mathematical thinking, actions, or language.

Susan, on the other hand, explicitly articulated explanations about her conceptions of mathematics and specific mathematical topics, ways of teaching mathematics, and how children learned mathematics. Already having some understanding of most of the mathematical concepts underlying the instructor's computer microworld tasks, Susan learned with others, reflecting and commenting on her partners' work, and suggesting alternative actions. Communicating mathematically was important for her own learning and that of her students; as Susan said, "the things that were much more meaningful to me are the group work and the class, class-wide discussions." Consistent with Moreira and Noss' (1995) study, learning styles influenced Robin and Susan's ability to construct an understanding of elementary mathematics topics.

There remained a contradiction between Robin's enjoyment in figuring out knowledge related to computer actions by herself and her fear in figuring out knowledge related to mathematical actions and ideas. Unlike in the Moreira and Noss study, Robin's lack of confidence with mathematics and familiarity with computers did not develop into a "deeper confidence" with reconstructing her knowledge about mathematics. When Robin talked about the mathematics of the computer tasks, she felt that the tasks were "very hard" and too "abstract" for her own understanding and that of her third graders. It seemed that Robin disliked the computer tasks because she could not depend on the role visualizations played in her understandings of mathematics to come up with a mathematical explanation on her own. Still, significantly influenced by her interactions with the TIMA microworlds, Robin commented that the microworlds were a "good way" to make things a "little more abstract" than using manipulatives because the students could still see things on the computer screen but they could not touch them. She said, "Now they have to make a connection from something that they see in their brains and not with the touching." Because the objects of the microworlds helped Robin visualize a unit, she reflected upon her understandings of children's construction of number knowledge. For example, Robin defined the term *composite unit* by specifically using the Toys microworld to string and chain five shapes until 45 shapes appeared. When I asked Robin how the microworlds helped her understand children's mathematical learning, she talked of things making "sense" when she could actually see the connected units (e.g., strings and chains) and the separate, individual units (e.g., the single shapes).

Robin's conceptions of teaching mathematics with technology remained relatively constant throughout the course. Teaching mathematics with technology meant using the overhead projector to demonstrate activities and problems with manipulatives during direct, whole-class instruction, or using computers for drill and practice and problem solving during individual instruction. Once Robin showed her students how to do the computer actions related to the software, she expected her students to work alone without any teacher intervention.

Working with a classroom set of calculators fit Susan's pedagogical approach to teaching mathematics; that is, she controlled and directed the activity of all students working on the same task at the same time. Susan valued and encouraged the development of a mathematical discourse community in which small-group and whole-group discussions focused on both Susan's and some of her students' mathematical thinking, strategies, and solutions. However, using computers in her classroom brought on feelings of questioning their value for her teaching of mathematics. In Susan's words,

> *The computers though is where I feel unclear about ... Is there something that makes TIMATOYS a better tool then the fraction bar set or fraction factory .... I guess more the essence of my question is when is it appropriate to use that [TIMA microworlds] rather than just the blocks on the desks?*

Shifting from a teacher-controlled, interactive teaching style of doing and talking about mathematics to a student-controlled, non-interactive teaching approach where students interacted with the computer and their partner did not make sense to Susan as an acceptable way to learn mathematics. Even though Susan enjoyed the control over her own learning that she experienced while working with the other teachers and the TIMA microworlds, she became frustrated with having little, if any, control over or interaction with her students while they worked in pairs with the Toys microworlds. As Susan said, "I have no idea what they did. You know, I mean I was teaching the rest of the class .... So they all cycled through it, but I don't know what value it was." The introduction of microworlds on one computer into a mathematics classroom did not support an "all or nothing" interactive pedagogical approach.

Both Robin and Susan found the task of providing a meaningful conceptual explanation of why the invert-and-multiply algorithm works for the division of fractions to be a major conflict in their thinking. It is interesting, however, to contrast the two teachers' experiences. Robin openly expressed her feelings of being "terrified of math" and frustration with spending so much class time on the division task. In contrast, Susan enjoyed the challenging task and persistently went back and forth between the physical context of a scarves word problem (i.e., How many scarves can we make if it takes 2/5 of a yard to make one scarf and we have 3/4 of a yard of cloth?], the Sticks microworld, and the symbolic language of mathematics. The processes of relating the actions and objects of the microworld to why the invert-and-multiply algorithm worked engaged Susan in thinking deeply about the nature of fraction concepts and operations. Over the last five graduate class sessions, findings from the case study of Susan support one of Goleman's (1995) interpretations of emotional intelligence. By motivating one's self, Susan had the ability to focus on an important goal (i.e., constructing a relationship between the Sticks microworld and why the invert-and-multiply algorithm works) during which she moved into a state of flow (i.e., high concentration) that facilitated her persistence in working on the task. Susan's work on this task engaged her in participating in "mathematical learning" that she described as forcing her "to think about really tough things."

As the study progressed, Susan's conceptions of teaching mathematics with technology changed somewhat. Drawing on her experiences in the graduate course, Susan changed the focus from teaching mathematics with technology to teaching mathematics with tools in order to think and talk about mathematics. Susan's experiences of talking about mathematics while using the TIMA microworlds, listening to the ideas of the other teachers, and providing explanations about how "tools" (e.g., manipulatives, microworlds, etc.) enhanced her own and her students' mathematical learning, strengthened her conception that technology makes things "easier." For example, the perturbation of the invert-and-multiply task afforded Susan with the opportunity to actually see two sticks rather than one stick being compared on the computer screen. In turn, she thought about and discussed her fragile understanding of how different interpretations of division relate to why the invert-and-multiply algorithm works. Moreover, this enabled Susan to fit her newly constructed ideas about students rather than the teacher deciding which manipulatives as tools would be useful in solving a mathematical problem, and still keep her interactive pedagogical approach of teaching mathematics. No longer did the construct of technology remain isolated as a separate entity. Even though Susan questioned the value of technology through the use of a one-computer classroom, she accepted the value and usefulness of teaching mathematics with tools that included not only computers, but manipulatives, calculators, rulers, and other resources found in elementary school classrooms. In short, technology began to lose its status as an add-on component when Susan transformed the term into the more encompassing word of "tools."

By the end of the course, both Robin and Susan did not use the TIMA microworlds in their teaching of mathematics. When teaching with the microworlds, Robin explained they could be used "to remediate certain concepts," but she became "overwhelmed" with the time it took to work with students individually and discontinued their use. In Susan's words, "I haven't figured out how to use one, with one computer what kind of activity I can have the kids go through without me there sitting by their side to direct it." However, Susan's statement persisted as a contradiction to her conceptions of students being able to learn mathematics with microworlds. She believed that students "created" mathematics with the microworlds, could take control and try out their ideas, and develop "their own concepts about it along the way."

Discussion

As part of a larger study, only two assertions are presented here. First, change in mathematics teaching warrants change in teacher's conceptions of mathematics and learning. Robin's experiences in the graduate course did not transform her into becoming a learner of mathematics, and she did not construct an understanding as to why improving her own learning of mathematics could facilitate her teaching of the mathematical concepts and skills contained within the third grade curriculum, or her teaching of mathematics with technology. Second, personal learning preferences and styles influence the process of teachers' learning in technology-enriched environments. Susan's positive experiences of constructing relationships between multiple representations of mathematics and articulating the language of mathematics, by providing explanation to others, contributed to her ability to discuss and make explicit the mathematical ideas that she already knew related to the computer tasks, and to crave the intellectual challenge of rethinking mathematical ideas at a higher level of understanding. By considering the multi-dimensional aspects of teachers' conceptions, the potential exists for mathematics teacher educators to create differentiated tasks that promote teachers' reflection when learning and teaching mathematics with technology.

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General Session: Technology Implementation

Fifty Ways to Use Technology as an Administrator: A Model

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Key Words: **Internet, administrators, staff development, technology**

The presentation discusses how K-12 administrators can effectively and efficiently use Internet as a research and personal tool. This model helps administrators learn how to do the following:

- search the Internet effectively
- learn to evaluate Internet information
- find information about national and state organizations
- locate national and state content area standards

- gather assessment strategies
- locate technology planning strategies
- review educational and technology policies
- get news and weather information quickly
- check copyright policies and information
- find listservs for administrators
- gather useful statistics

Attendees will view a number of useful sites for administrators and gain tips on how to help K-12 building administrators make the Internet a time-efficient tool in their office. Ideas for presenting staff development sessions for administrators will also be offered. Administrators who attend will glean a number of useful ideas and time saving strategies for winding their way down the information highway and for providing the educational leadership in the building to see that this wonderful tool, the Internet, is used wisely.

General Session: Curriculum and Instructional Strategies

Nine Keys to Unlock Great K–12 Educational Web Sites

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Key Words: **online learning, World Wide Web, K–12 Web sites**

The purpose of this exploratory study was to develop, validate, and make available an optimal set of quality indicators that can be used by K–12 educators, educational policy makers, and developers of K–12 educational Web sites to identify or to create quality Web-based online learning experiences. Online learning experiences were defined as Web-based educational resources that provide K–12 teachers and learners with virtual environments that accommodate a variety of learning styles and require active participation and meaningful, high-level thinking in interactive and collaborative learning communities.

This study addresses the following seven research questions:

1. What categories of indicators are considered by experts to describe a quality online learning experience?

2. What relative importance do experts place on each of these categories?
3. What specific quality indicators are considered by experts to define each category?
4. What relative importance do experts place on each quality indicator within a specific category?
5. What are the differences among the ratings of the quality indicators assigned by the three panels of experts participating in this study?
6. Is there a relationship between the highest rated quality indicators and the participant's (a) expert panel assignment, (b) years in education, (c) Web use experience, and (d) frequency of Web access?
7. Do Web sites chosen by the members of the three panels of experts reflect the quality indicators identified by this study?

This study employed a purposive sample of national experts who design, use, and recommend online learning experiences. These experts were placed in three panels: (a) 20 educational users of online learning experiences, (b) 20 reviewers of Web-based resources, and (c) 17 developers of educational Web sites. The three expert panels were surveyed with a questionnaire distributed in June and July of 1998. The questionnaire asked respondents to rate the importance of 10 quality indicator categories and 74 quality indicators.

A checklist reflecting the nine quality indicators most highly rated by panelists was developed and employed to examine 27 panelist-nominated online learning experiences. This phase of the study validated the nine highly rated quality indicators as reflecting the characteristics of a quality online learning experience.

General Session: Current and Emerging Technologies

Web Sites to Promote Teaching and Learning and Facilitate Management

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Key Words: **interactive Web sites, data management, Internet/intranet**

This session will include creating and using interactive Web sites for instructional purposes at the school and district level. We will use Microsoft Access database software, Cold Fusion software, and a Web editor in this session. By utilizing online forms for data entry, results can be automatically transferred between your form and your database drastically saving time and resources. We will show you how to create a simple database and create the online form to go with it. After uploading these to a Web server, we will go online, fill out the form, and submit the results to the database. We will then create a Web page that allows you to search the database for relevant information. We will also show you examples of interactive Web sites our district uses for instruction and management.

A limited number of participants will receive an evaluation copy of Cold Fusion software and can register to win one of two full versions to be given away at the end of the session.

Some examples of interactive Web sites that we have created in our district that are useful in education include the following:

- Lesson Plan Forms that enable teachers to submit lesson plans online. Teachers than have the capability to search for lesson plans that integrate technology into their curriculum. Searches of the database can be done on grade level, subject area, topic, theme, or keyword.
- Interactive Educational Web Sites which allow teachers/students to search for relevant Web sites by grade level, subject, theme, or keywords.
- Technology Surveys for Teachers and Students that are used to assess growth and determine staff development needs for individual teachers or students, or needs at the school or district level.
- Reading Resource Library accessible to teachers and parents.
- Technology Service Request and AV Repair Request Forms that schools use to submit service orders for technology and AV equipment. Work orders are submitted into the database and can be queried by school and date of requests for faster and more efficient service. School contacts and individual teachers have the capability to check on the status of their school's service orders.
- Staff Development Evaluation Forms to determine the success of staff development opportunities districtwide.

After attending this session, you will know how easy it is to create interactive Web sites for instructional purposes and have an idea of what is needed to create your own interactive Web sites.

General Session: Using Technology to Facilitate Learning

Integrating Information Literacy/Technology Skills into the K–12 Curriculum

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Key Words: information literacy, standards, research, thinking, technology

Information literacy is the ability to identify, locate, understand, evaluate, and use needed information effectively. It relies on a set of critical skills that form the foundation of national and state standards in most disciplines. Although these skills are not new, many of them have become both more complex and more important. Evaluating information for validity, accuracy, and reliability, for example, has become essential in this age of Internet-based information.

In Somers, we began to develop our model for integrating today's information literacy skills into the K–12 curriculum by surveying the literature on the teaching of research. In addition, we have taken into consideration current research on the brain and, more specifically, its implications for how we develop our students' ability to think. Our goal has been to lead a district-wide initiative to redesign curriculum that focuses on the teaching of specific thinking skills which will, ultimately, produce information literate citizens who will thrive in our current society. The incorporation of technology skills is assumed in that more and more information is accessed through technological means. We have also found that it serves as a catalyst and a vehicle for redesigning curriculum that focuses on thinking.

General Session: Technology Implementation

Creating a New Learning Environment through Partnerships

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Key Words: **partnerships, elementary, classroom applications, science, e-mail, collaborative**

The School District of Upper Dublin used a $3 million technology bond issue in 1995 to create a new learning environment. The five buildings and 4,200 students are connected to the Internet through a 1,000-computer multiplatform enterprise network and the BESS filtering system. Every K-5 classroom has a minimum of two multimedia networked computers and each 6-12 classroom has a minimum of one multimedia networked computer.

This session will discuss how the third and fourth grade educators became "guides on the side" to facilitate learning into an ongoing, lifelong process. In 1998, the district decided that the third grade would be a perfect place to pilot this "educational revolution." This pilot project was so successful that district personnel expanded the technology to the fourth grade classrooms in the fall of 1998. A variety of customized inservice trainings were offered where third and fourth grade teachers learned how to use the new equipment and manage the classroom. Each classroom is equipped with six networked computers, a flatbed scanner, digital camera, direct Internet connection, and a wide variety of software and research CDs. The educators developed a draft of technology content standards and agreed to integrate the technology into at least one curricular unit. During the 1998-99 school year, the teachers jointly developed their curricular units and standards for basic technology skills, word processing, desktop publishing, research, and creating presentations.

A partnership component between Upper Dublin School District fourth grade students and LaSalle University preservice students was achieved through a Technology Literacy Challenge Grant. The students in both locations study core concepts in their curriculum and are teamed together to conduct open-ended investigations of their local environment. Mentoring relationships have been created between college/elementary students as well as among the college/elementary teachers. LaSalle students involved in elementary classrooms learn about inquiry as a teaching tool as they learn science content. The pilot project included an environmental center field trip and a curriculum unit on plants. The scientific inquiry activities are facilitated through videoconferencing CU-SeeMe software and e-mail.

General Session: Curriculum and Instructional Strategies

Webbing In and Out of Electronic Books

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Key Words: literacy development, electronic books, CD-ROM, Web-based

Electronic books, as animated versions of narrative texts, heighten attention to the plot, the setting, and the characters. Because of their infinite patience, electronic books allow students the luxury of repetition without the need for teacher assistance to revisit the story and the actions of the characters and setting components. Electronic texts, especially those that offer expository text, broaden students' exposure to content with the layers of information offered on every screen. Research shows that electronic books extend students' sight vocabulary and provide effective individual support for those with reading disabilities. The positive reaction to electronic books is evident by their ample supply on CD-ROM and the Web.

Many questions continue to arise about electronic books. First, what electronic books actually are available on CD and through the Web? Are they a good replacement and/or support for traditional printed books? What are the similarities and differences between reading traditional printed text and electronic text? What are the advantages in general of using electronic books to support students' conceptual development? What are the disadvantages? What are the differences in using Web-based versus disc-based electronic books?

This session will answer these questions with the demonstration of two electronic books from each platform. Part of this demonstration will include a framework for creating lesson and unit plans that use electronic books to integrate concepts, content, and skills. In addition to comparing these texts with traditional printed text, an analysis of the relative merits of each medium will be offered from the perspective of their sensitivity to the cognitive capacity of learners.

For example, Brøderbund's CD-ROM version of *Arthur's Reading Race* will be shown as part of a unit plan on determination that helps students appreciate the positive impact of practice on learning. Strengths and weaknesses of this electronic book will be presented along with the activities that support the use of this book. A comparable electronic book from the Internet will be presented in a similar manner so that the participants can see for themselves quantitative and qualitative differences between these mediums. Each medium's contributions to and/or distractions from students' learning of content and concepts will be displayed through a model of readers' cognitive resources.

The three presenters are in the process of co-editing a book for the International Reading Association entitled, *"As You Like IT!" Instructional Technology for Literacy Instruction*. Because they have been actively involved in working through the aforementioned ideas and issues in this manuscript, they will be able to share both the theoretical and practical applications of electronic books. The three professors bring their experience from educational psychology, reading instruction, and instructional technology to this presentation.

Thus, participants should leave this session with a more vivid understanding of the role that electronic books play in literacy development. The presenters hope that participants will come to understand that electronic books, per se, are not the determining factor for use. Rather, the conceptual thinking and creativity behind the design of each electronic book must be taken into account to evaluate its appropriateness for students. These factors for evaluation will be part of the packet distributed to participants that will also include a listing of electronic books and accompanying lesson plans.

General Session: Curriculum and Instructional Strategies

Leadership in Integrating Mathematics, Science, and Technology in the Elementary School

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Key Words: **technology implementation, teacher education, promoting interdisciplinary learning**

This session reports on the highlights of a multimillion dollar, NSF-funded, teacher enhancement project: Integrating Mathematics, Science, and Technology in the Elementary Schools (MSTE). The primary focus is on computer-related instructional models associated with the project.

A brief description of the project is as follows: The MSTE Project is a five-year, 7.4 million dollar Project (4.2 million from National Science Foundation funds, 3.2 million from Project partners) launched in the summer of 1997. It is a major reform initiative in New York State, undertaken by The State University of New York (Stony Brook), Hofstra University, and Brookhaven National Laboratory. At these three sites, participants engaged in extended workshops during two 20-day summer sessions in 1997 and 1998. All workshops were conducted within a learner-centered, investigatory learning environment. This session describes and illustrates how computer technology facilitates and promotes interdisciplinary learning in mathematics and science at the elementary school level.

Participants in the project were inservice teachers from 20 different school districts, three-members per team (N = 60), who had been identified by their district administrators as potential leaders for implementing the New York State MST Learning Standards. These same participants will continue in the project until the year 2001. The program focuses on exemplary practices, leadership paradigms, and integrated MST instruction for New York State elementary schools.

After completing the first two years of the project activities, participants will be designated as District MSTE Leaders. During project years three and four (summer 1999 and 2000) they will conduct staff development sessions for colleagues (N = 600) in their local districts; during the fifth year (summer 2001) participants will conduct statewide leadership and dissemination workshops (N = 1200).

Exemplary software, teaching materials, and books are provided, as well as stipends. During the academic year, participants research and explore the use of the new materials within their own classrooms and benefit from peer coaching and full administrative support. Internet software is provided and accounts are fully paid for by the project.

This session provides an overview of the project, a number of integrated MST curriculum units, and illustrations of the computer component of the project. Illustrations include models employing interactive software applications, distance learning, and communications. Attendees will gain access to models for integrating mathematics, science, and technology in the elementary school, as well as a structure for systemic change to promote MST integration at the state level.

Predicting the Future by Creating It: Five Technologies Transforming Education

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Key Words: **technology, future, technology integration, virtual reality, voice recognition, wearable computers, electronic books**

Educators often find themselves in the uncomfortable position of reacting to calls for school reform and restructuring based on conditions that became apparent to society quite suddenly. Most reform movements force educators to react quickly with solutions to meet these new conditions and demands. Now, however, we in education have an opportunity to create an education system based on what we can predict will happen in the future, not only in terms of future needs but future resources that will be in place to meet them. This presentation proposes that predicting technologies which could transform our society and being able to visualize their potential for education is as critical a skill to educational leaders as using any of today's technologies.

Peter Drucker said, "The best way to predict the future is to create it." This presentation will demonstrate five technologies with the capability to help us create the education system we want.

Five Transforming Technologies

Wearable Computers

Description. Whole computer systems can be worn so that they can be easily carried while working with them. Interfaces include voice recognition, head mounted displays, and pen tablets.

Potential Impact. Continual non-obtrusive computer access takes portable computing to the next level, similar to how cellular phones have changed communication. Combined with wireless communications, Internet and e-mail, access will be available everywhere.

Applications in Education. Current applications are primarily in industry, public works, transportation, utilities, medical teams, and the military. Educational applications would include students being able to access resources anytime or anywhere (in the classroom, on fieldtrips, during lunch!), automatic attendance-taking, and being able to locate and communicate with students at any time.

Softbooks®

Description. Softbooks are a brand of the kind of flat displays that are similar to those on laptop computers, but which can be held in your hands like a book. Current systems can download full text documents and books to the system. Utilities include the ability to search, annotate, highlight, bookmark, and link reference material.

Potential Impact. Greatest impact on the printing industry. Users will be able to carry multiple publications (4,000 pages) in one book-size device. Bookstores will become totally online.

Applications in Education. Systems just beginning to be marketed. Students can carry all of their books in one location. Campus bookstores will download books instead of stocking them. The lower price of publications (due to lower production costs) can make access to better materials more equitable.

Voice-activated Programs

Description. Speech recognition programs (input) which allow control of the computer through voice commands and text input directly into programs like word processing without keyboarding. Text-to-speech programs (output) will read text and convert text to speech.

Potential Impact. Hands free computer control and input allows access to visual and motor impaired people.

Applications in Education. In addition to easier use of programs by all students, voice-activation (rather than keyboard input) will bring about a gradual shift from writing and reading skills to an emphasis on speaking and listening skills.

Virtual Environments

Description. VR environments ranging from on-screen 2-D visualization to full immersion 3-D systems (including (CAVEs) to simulate real or imaginary objects or places. Included will be head mounted displays, voice interaction, and tactile gloves.

Potential Impact. Now used for entertainment and interactive simulations for education, training, and research.

Applications in Education. Future applications will be in industrial prototyping (automotive design), medical research and training, and virtual field trips.

Distance Options

Description. Advances in distance networking, high speed Internet connections, and broadcasting options promise to make more and better quality distance learning available.

Potential Impact. Distance limited to Web pages or special training sites. High speed access will allow the same capabilities at home or at school.

Applications in Education. Reduced class and school sizes herald a change from home schooling to schooling at home.

Conclusion: What Future to Create?

Far-reaching changes to education precipitated by technology already have begun. Technologies like those described here promise to change the definition of "classroom" itself. Educators must be prepared to meet these shifting definitions with practical strategies.

General Session: Exhibitor

Software That Makes Learning Music Fun!

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Key Words: **music, music education, arts education, software, Macintosh, Windows**

Learn how to integrate music technology into your curriculum with an introduction to Harmonic Vision's award-winning Music Ace series for beginning and intermediate music students. Software titles include Music Ace and the new Music Ace 2.

Winner of nearly 30 awards and honors, including a 1997–98 Technology & Learning Software Award of Excellence, "Only the Best" from the Association for Supervision and Curriculum Development and an "All-Star Software" designation from Children's Software Revue, Music Ace offers students an engaging introduction to music fundamentals and theory covering concepts such as note reading, staff and keyboard relationships, key signatures, and more. The new title, Music Ace 2, takes music theory instruction to the next level introducing concepts such as standard notation, rhythm, melody, harmony, intervals and more.

Mr. Wilken, a former music educator, will provide insight on how elementary and secondary educators are using Harmonic Vision software in both group and individual learning situations, showcase the Music Ace Series assessment features for tracking group and individual progress, and illustrate how the series meets many of the National Standards for Music Education.

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Research Paper: Curriculum and Instructional Strategies

Equity: Ownership by Minorities and Women of Research Projects

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Key Words: **women, minorities, presentations, research, students, calculus**

Clearly, the last decade has seen a tremendous change nationwide in the teaching of calculus. Starting in 1987, a reform movement got underway. It was a response to high failure rates (as many as 40 percent of undergraduates were failing introductory calculus) and the perception that the students were merely learning by rote, unable to apply mathematics to real world or complex problems. The reform movement was heavily funded by the National Science Foundation which spent 35 million dollars from 1987 to 1995 on dozens of projects to change the teaching of calculus. A survey by the Mathematical Association of America (MAA) found that by 1994 a majority of institutions had made modest or major changes in how calculus was being taught and that a third of the students taking calculus in the United States were enrolled in a reformed course.

The hallmarks of a reformed calculus approach include:

- Emphasis on students working in groups (collaborative learning)
- Working on long-term challenging real world problems (based on Uri Treisman's Berkeley California model)
- Writing and speaking about their work
- Using computers and graphing calculators to visualize and manipulate functions and families of functions
- Using computer algebra systems such as Mathematica and Maple to differentiate, integrate, and "crunch" data
- Encouraging students to do research

Borough of Manhattan Community College has been in the forefront of this movement. The college was already committed to students writing and speaking about their work. We had already learned that collaborative learning and the use of appropriate technology helped developmental mathematics students. We were concerned about low success and retention rates in calculus. More importantly, we were deeply troubled by the fact that those students in calculus were almost exclusively White and Asian American males. The woeful underrepresentation of women in calculus in a college that is two-thirds female was also of great concern. We were already looking for solutions for improving and making inclusive our calculus instruction. Active in our professional organizations, we responded quickly to calls for change by Ron Douglas, Ed Dubinsky, Deborah Hughes Hallet, Tom Tucker, David Smith, and others.

Borough of Manhattan Community College was the first two-year college to receive National Science Foundation funding for calculus reform and for the early years we were the only two-year college in the program. We received a total of seven NSF grants over an eight-year period. Funding allowed us to:

- Establish a state-of-the-art calculus computer laboratory.
- Purchase calculators, graphing calculators, and laptops.
- Send senior faculty to a week-long workshop with Uri Treisman on collaborative learning.
- Send Drs. Sher and Wilkinson to a two-week long workshop at Dartmouth with John Kemenny. The workshop focused on integrating computers into calculus, differential equations, and numerical analysis. We were the only two-year faculty invited. The invitation was based on prototypical calculus projects we had already created.
- Run workshops for City University of New York (CUNY) faculty on the use of MAPLE (a computer algebra system), graphing calculators, and collaborative learning techniques.
- Run two weeks of summer workshops at BMCC for seven to eight years (1992–1999) for hundreds faculty from all over the country.
- Run half-day workshops on computer use for adjunct faculty.
- Hire half-time College Lab Technicians and support staff.

Our program avoided the pitfalls of some reform projects that are currently receiving backlash from very traditional faculty members who long for a return to the good old days of straight lecturing and textbooks that do not emphasize the use of technology. The BMCC program adds labs, supervised by a laboratory technician, to the traditional classroom experience. Faculty are therefore free to use as much or as little changed pedagogy as they feel comfortable learning. Some faculty are totally committed to collaborative learning, even allowing some collaborative testing. Some faculty insist on teaching classes in a lab (or with classroom size amounts of graphing calculators) so the students can actually see graphs, rotate functions, etc.

as the need arises in class discussion. Others have not changed their teaching style, and rely on the lab to add the reform component. In the lab, students work together in groups on challenging problems. They learn to use a wide variety of software (Maple, Mathematica, Derive, True BASIC), and to write up and speak about their projects.

The BMCC program has been successful by a variety of measures. Grades and retention have improved. We have increased by six fold the number of students persevering through Calculus III. The success and increased numbers of calculus students encouraged us to go forward with a mathematics program. The program already has 50 "math majors," a larger number than some of our four-year sister CUNY colleges. Students are going on and succeeding as math majors at four year institutions. One student showing her portfolio of projects won a scholarship to Columbia. Each semester about 10 of our students are Alliance for Minority Program Students (AMPS) fellows receiving $2,000 stipends from NSF to pursue research on projects originally started in the calculus lab. One of our students won first place presenting "Animations of Taylor Series of Trigonometric Functions" at the fourth annual NSF-AMPS Students Research Conference in Tallahassee, Florida, in June 1996. More importantly, the ethnic make-up of students in the program is now representative of the college as a whole. We have had some, but not as much success, in breaking down the gender barriers. For example, the Fall 1996 evening Calculus III course had only one woman in the room and that woman was the instructor. The program has received national recognition. It tied for first place in the "Student Success Strategies in Applying Technology to Teaching and Learning" competition at the National Council of Instructional Administrators Meeting, Minneapolis April, 1995. The portfolio aspect of the program was the focus of an article "The Student Portfolio: A Powerful Assessment Tool" in ASEE Prism, *A Journal of the American Society for Engineering Education*, March 1996. Professors Sher and Wilkinson received NISOD awards for their work. They have presented workshop and papers at more than 20 conferences, including the MAA, AMATYC, NYSMATYC, and NCTM. They have spoken and had papers published in the proceedings of international conferences in England, France, and Germany.

What had not been done (the focus of this paper) was a project to elicit the students' perspectives on these reforms, particularly on the use of technology. Through a questionnaire and student interviews, it was attempted to assess how BMCC's students feel about themselves in pre-calculus and calculus classes, and in particular, how they feel about the use of computers, graphing calculators, working in groups, and creating written research projects and portfolios of their work. Students were asked, on a scale of the 1 to 5, how strongly they agreed with 15 statements (N = 300). Comments were also solicited. Data was analyzed for the whole cohort and then by gender to see if women responded differently than men. The results follow:

1. I think of myself as a good math student.

The majority of BMCC's pre-calculus and calculus students agree or strongly agree with this statement, indicating confidence in their ability. However, when data is analyzed by gender or by whether students are advanced or intermediate, there are significant differences. Men rate themselves significantly higher ($\alpha = .05$) than women and the longer students are in the program, the more highly they rank their ability.

This finding is hardly surprising. In fact, it simply supports hundreds of studies that indicate men are much more confident than women in the mathematics arena. This is often independent of success and/or grades. Successful reform strategies should be pushed back to earlier courses to give women more time to build their confidence. More attention should be paid to the affective aspects of instructing women.

2. I like to solve math problems.

Again, the majority of students support this statement. There were no significant differences by gender. This was a little surprising since several studies on the underrepresentation of women in mathematics hypothesize that women are not "risk takers" and therefore like to avoid math problems. There was, however, a significant difference ($\alpha = .01$) by course level. The longer students are in the calculus program, the more strongly they support the statement. The program succeeds in encouraging students' problem solving interest, an important aspect of mathematics.

3. I am nervous when I need to solve math problems.

Students indicate that many are indeed nervous when approaching problems. There is a vast literature on mathematics anxiety and it suggests that even very good students can be somewhat anxious. Like the seasoned actor who still gets opening night jitters, some good math students approach problem solving with their adrenaline pumping. What was surprising was that there were no significant differences, either by gender or advanced standing. So much of the literature characterizes women as math anxious or math phobic but at BMCC there was no real difference. Men as well as women, and advanced students as well as intermediate ones, are nervous about solving problems.

4. I can usually picture in mind what the graph of an equation or function will look like.

The majority of students select neutral, disagree, or strongly disagree, i.e., they do not easily visualize abstractions. However, there are very significant ($\alpha = .01$) differences by gender and class level. Men report significantly better ability than women and students in higher level classes are more confident of their ability to visualize. Numerous studies have reported that women come to mathematics handicapped by poor spatial relations and visualization skills. Starting in adolescence, women lag behind men in tests involving spatial abilities. Beginning with childhood toys and games, girls have limited practice in spatial visualization, an important tool in mathematics. But it has been shown that even in adulthood, intervention programs can equalize women's spatial task performance with that of their male peers. Women should be exposed earlier in their mathematics careers to the use of graphing calculations and to computers, to make abstractions "concrete."

5. Math is something you can learn only by yourself.

Students for the most part reject this statement, i.e., the majority realize group work can produce learning. The higher level students reject the statement more than the intermediate level, although the difference is not statistically significant. However, when means are compared by gender, males are significantly more likely to support the statement (i.e., males think of mathematics as a solitary activity more than females). Collaborative learning apparently taps the verbal and social skills of women. Students, but women in particular, reject the contention that mathematics can only be learned by yourself.

6. I like to work in small groups to solve problems.

This statement closely relates to the previous one and has a similar response. Although not statistically significant, the more advanced students are, the more they prefer group work. Women ($\alpha = .05$) prefer small group work more them men. Students and women in particular like small group work.

7. I have used computers in math.

Most of our students have used computers in mathematics. Men have more computer experience than women. Advanced level students overwhelmingly report greater use of computers. The difference between advanced level and intermediate level students is significant. We need to find out if lower level courses are not using technology because of faculty disinterest or lack of availability. If the latter, our new ILI Grant for laptops and graphing calculators will help.

8. Using computers helps me to learn math.

Almost half the men and two thirds of the advanced students support this statement. Few students disagree with the statement; although many are neutral. There are statistically significantly more men than women who believe computers are useful, and advanced students, again at statistically significant levels, support computer use over lower level students. We need to be sure women are getting equitable access to computers and introduce them earlier in their mathematics lives.

9. I have used a graphing calculator.

It is interesting to contrast the responses to this statement with those to statement 7 (I have used computers). Here, the responses are absolutely antithetical. Significantly more women than men have been exposed to calculators and significantly more intermediate students have used calculators. Women who enter the program at lower levels (Intermediate Algebra) than men do not get to use computers until later. Again, our ILI Grant for laptops may allow us to bring computers to earlier courses.

10. Graphing calculators help me to solve math problems.

The responses here were similar to those of statement 8. Almost half the men and over half the advanced students support this statement and few students disagree but a large number of students are neutral. Significantly more men than women, and significantly more advanced students, think calculators are helpful. Calculating a correlation coefficient for response to statement 3 (I am nervous.) found an extremely small negative correlation.

11. Computers and/or calculators help me to visualize graphs better.

A majority of students support this statement. Again, significantly more males than females support technology for visualization and significantly more advanced students (81%) find technology helpful for visualization. Calculating a correlation coefficient between responses to statement 4 (I can usually visualize) and statement 11 found small but positive correlation's for all groups, the largest correlation being for women.

12. Computers help me solve math problems better.

There is strong support for this statement by all students with no difference by gender (i.e., women as well as men find computers helpful to solve problems). There is, however, an extremely large difference by class level; the more advanced students strongly support this statement. Students, particularly students in advanced courses, support the use of technology to help solve problems.

13. I have created written projects in math.

Significantly more men than women, and overwhelming more advanced students, have created written projects.

14. I have created written projects in portfolios.

The use of portfolios is prevalent in advanced courses with 40% of the students supporting this statement, while only 5% of intermediate level students have created portfolios. There is a significant difference by gender; more men have been involved in portfolio creation.

15. I believe projects and portfolios help my understanding of math.

While many students rate this statement as neutral, many (see above) have not worked with portfolios. Advanced students strongly support this statement (only 7% disagree). Men find projects and portfolio more helpful than do women.

The questionnaire had three open ended statements:

1. Computers in math courses are ...
2. Graphing calculators in math courses are ...
3. Working with other students on math problems or projects is ...

Students were also invited to make any other comment they wished.

Only a third of respondents chose to add comments. Those that did were almost unanimous in their enthusiasm for the use of computers, calculators, and group work. For example, only one student said he preferred to work alone. I do not, however, think the sample of comments represents the population as a whole. Students who took the time to add comments probably represent those most enthusiastic about reform activities.

1. The open ended statement "Computers in math courses are" elicited such typical comments as:

   "A whole new approach. I feel I am part of the future."

   "Essential. I am going to live in a high-tech world."

   "Good for seeing what an equation really looks like."

   "Very helpful in solving long, complex problems."

   "Powerful. Maple helps me a lot."

   "Great. I finally understand what polar coordinates are about."

   "At first I was scared, but computers are easy to use and now I like going to the lab."

2. The statement "Graphing calculators in math courses are ..." brought responses such as:

   "A good idea, the calculator has many useful modes and options, i.e., you can find intercepts and exact points."

   "Useful; easy to use and handy to do long math problems"

   "Very valuable. It puts into perspective what is really happening to a graph."

   "Very helpful in understanding graphs—and fun!" "Makes problems easier to understand."

   "Exciting"

   "Helpful because they help me see things clearer."

   "Very helpful for checking algebraic answers graphically. Gives you an idea what results really mean."

3. Working with other students ... elicited the following typical remarks:

   "Great, you can discuss different methods with your partners."

   "Working with other people is very interesting. Sometimes we, as math students, get confused but another person helps us really understand."

   "It is important to see there are different approaches."

> *"Very helpful. There is always something that somebody understands better than someone else."*
>
> *"When I am stranded it helps to be able to ask for some ideas."*

Interviewing students produced very similar results. The students I talked with are not a random sample of students involved in the program. They represent, instead, those who were willing to spend some time talking to me. They were much more likely to be students who "hang out" in the Calculus lab during its open hours, i.e., students heavily involved with team or in the math club. I was not surprised therefore at their universal support for the use of technology and group learning. What was surprising was how articulate, dedicated, and serious they are.

While the outside evaluator of the nondevelopmental math courses was on campus this Fall; he asked to visit the Calculus lab. It was during an open hour (i.e., no class was using the facilities) that I spotted one of the students I had talked with. She was working on an animation project in polar coordinates. By using the software MAPLE, a computer algebra system, she was creating moving images on the screen that showed how the graph changed as she changed variables in her equations. She is an Alliance for Minority Participation (AMPS) fellow and this was her culminating project. The evaluator asked her to explain what she was doing and was amazed by her response. She said: "What level of explanation do you want? Should I start by explaining what polar coordinates are? Do you want to know about the software that allows me to graph my equations? Would you like to know about the program I wrote, that allows me to animate my equations? Do you want to hear what I am concluding based on my animations?" Her grasp of the various levels of knowledge and skills she was using and her articulateness in explaining what she was doing made it clear she was functioning as a working mathematician. She is typical of many students in the program; they are not just "learning" mathematics, they are "doing" mathematics, which is what a working mathematician does.

This study suggested strong gender differences in the calculus classroom at BMCC. Women are less likely to see themselves as good math students (regardless of their grades), less able to picture equations or function in their minds, report less computer use, and are less likely to find calculators and projects helpful. However, they prefer small group work more than men and are less likely to believe math is something you can learn only by yourself. Because the typical BMCC woman enters the college with less academic mathematics preparation than her male cohort, she starts her mathematics career in lower level courses. These courses are much more likely to be taught without technology and in a traditional lecture format. The course is also more likely to be taught by an adjunct than by a full-time faculty member. There is therefore a need to increase our efforts to make adjuncts comfortable using graphing calculators and computers, and to push successful strategies to earlier courses. We need to increase sensitivity to make women equal partners in the classroom and laboratory.

As a result of this study, faculty at BMCC applied for and received an NSF Grant (1997-1999), Portfolios to Increase the Number of Women in Mathematics, NSF-HRD 9710273, aimed at changing the culture and climate of mathematics instruction to improve the representation of women in mathematics.

The grant is providing resources to move the use of technology, and portfolios of work, back to pre-calculus and statistics courses in order to involve women earlier in their academic careers. Students are being encouraged to work in collaborative groups in these earlier courses. Emphasis is being put on visualization of abstract ideas. Students are encouraged to use graphing calculators and computer algebra systems to change, manipulate, and play with functions allowing them to "see" more clearly.

However, what is proving to be one of the most successful aspects of this new program is getting women students involved in research activities. As much of the literature suggests, getting women involved in real research, particularly if they work in groups or under a motivating mentor or role-model, has helped to retain them in science, engineering, and mathematics majors. This may be because some women prefer learning under teachers who do not act as authority figures but as "midwives" to student thinking, as a good research guide does. It also meets the often reported need of some women to tie what they are learning to real and relevant situations.

An example of this is SUNY at Potsdam College's mathematics majors. Investigators expected to cite the college for special sensitivity to gender or additional support for female students. Instead, it was found that teaching techniques were at the core of the success of the program. Teachers worked with students such that they recreated mathematics together. Students played the role of expert and found confidence in their own ability to create mathematical ideas. All students, female and male, were supported through a teaching style "true to the nature of mathematical inquiry." This teaching style appears to be preferred by many women who were interviewed for *Women's Ways of Knowing*. Research projects favor this way of learning.

Adopting this "midwife" approach to learning, in January 1998, nine women students worked under the direction of their individual mentor on a research project. Topics ranged from papers on women mathematicians and *The Mathematical Underpinnings of Childrens' Games in Africa* to a sophisticated computer animated analysis of Taylor Series as Symmetry in Three Dimensional Spaces. Most projects utilized graphing calculators or computers. During the summer of 1998, an additional 12 women students completed a variety of research projects. Other recent student activities include presentations:

> Five BMCC students, Mohamed Barry, David Cervetti, Raphael Iyageh, Jean-Windy Paul, and Mervyn Roach presented their work. "Animation of Series Approximations of Trigonometric Functions," at Launch Your Career: CUNY Conference in Science and Engineering, February 19, 1999.
>
> Five BMCC students, Mohamed Barry, David Cervetti, Raphael Iyageh, Jean-Windy Paul, and Mervyn Roach presented their work. "Animations of Series Approximations of Functions," at the National Minority Research Symposium, World Trade Center, NYC, November 23, 1998.
>
> David Cervetti presented "Animation of Trigonometric Functions," at the 1998 National Science Foundation-Alliance for Minority Participation Student Research Conference in Montana, July 1998.

Seven BMCC students, Mohamed Barry, David Cervetti, Raphael Iyageh, Anta Niang, Jean-Windy Paul, Mervyn Roach, and Jamilah Seifullah, presented their work, "Learning by Doing: Student Research through Animation," at the NSF sponsored *Shaping the Future* conference at BMCC on May 8, 1998.

David Cervetti's talk on his animated research project was one of the highlights of the student presentations on February 20, 1998, at The Urban University: A CUNY Conference in Science and Engineering.

Ms. Jamillah Seifullah, "Animation of Polar Functions and Taylor Series," MU-SPIN National Aeronautics and Space Administration (NASA) Conference, October 1997 in New Jersey.

Ms. Jamillah Seifullah, "Animation of Polar Functions," at the 1997 National Science Foundation-Alliance for Minority Participation Student Research Conference in New Mexico, July 1997.

Ms. Jamillah Seifullah, "Animation of Taylor Series," at the May 3, 1997 Metropolitan MAA Annual Conference in Dobbs Ferry, NY.

The Mathematical Association of America (MAA)/Tensor Foundation endorsed our student research by awarding the college a $5,000 grant (matched by the college) to provide stipends for women involved in the program in 1998-99. This endorsement was reaffirmed by a renewed $5,000 grant for women's research fellowships for 1999-2000.

While the program is still in its initial stage, we have already seen results. Several women who expected to make Calculus I their terminal mathematics course have opted to continue in the calculus sequence, giving themselves more options in the SEM areas. Several students have extended their initial research projects to earn honors designations for their subsequent calculus course. Students have used their research projects in interviews for admission to private four year colleges, and in several instances have earned scholarships.

The Mathematics faculty at Borough of Manhattan Community College are committed to finding the most effective ways to use technology to encourage women and minorities to feel comfortable in a mathematics environment. Research projects using technology are proving to be an effective strategy.

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General Session: Current and Emerging Technologies

Geographic Information Systems: Not Just for the Real World Anymore

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Key Words: **Geographic Information Systems, GIS, curriculum integration, projects, training**

As more people are wanting to be able to gather, analyze, present, and distribute huge amounts of data in order to answer practical questions and solve problems in their lives, the real world use of GIS has exploded in the past few years. From city planning to reforestation, the power of using GIS is all around us. Educators and students K–12 can also integrate GIS into the curriculum to enhance education in multiple grades and disciplines.

Learn how you can receive training on using the software ArcView-GIS and incorporate it into a large number of high school subjects, not only the geography classroom. GIS is useful in subject areas such as science (geology, earth science, archeology, biology, chemistry, ecology, physics, zoology), mathematics (algebra, geometry, calculus), business education (marketing, technical studies) and the social sciences (anthropology, history, sociology, political science, economics). GIS is a excellent tool for teaching in a single subject area and for engaging interdisciplinary teaching.

Topics include:

- Examples of projects from high school classes that are currently using GIS in the curriculum
- Examples from city planning agencies, federal government sources, business agencies, and other professionals who employ GIS in their work

- Ideas for the potential GIS holds in education
- Practical guidelines for implementation in schools

Attendees will be given packets of information, articles, posters, software and lessons developed by ESRI (Environmental Systems Research Institute, Inc.) on the use of GIS in the K-12 curriculum. All materials are distributed free and with permission. Information on workshops conducted by the Center for Image Processing in Education will also be available.

Society Session: Laptops

Sponsoring a High School Programming Contest

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Key Words: programming, extracurricular, clubs, peer interaction, high school

A programming contest is not only fun for the participants but contains hidden benefits. One benefit is that because most contests involve team competition, students must work together. Learning to analyze and solve a problem as a team is an essential ability for students to develop. In addition, a contest is a great way to motivate students to apply the skills they have learned in their computing classes. New computing and communication technologies, and the variety of effective software, provide a means to configure an excellent programming contest—one that matches the interests and skills of the students who will participate. A third benefit is that students meet their peers from other schools. Finding that they all have similar skills reinforces what they are being taught.

For a programming contest to be successful for students and sponsors as well, it must be well planned. There are many decisions to be made and logistics to be arranged well in advance of the contest. This session will provide discussions and examples of what has been successful at a variety of programming contests.

Topics include:

- Determining if you have an appropriate site to host a contest
- Hardware and software considerations
- How to fund the contest
- Decisions about team composition
- Rules for programming contests
- Appropriate procedures during the actual contest
- Suggestions for judging the contest
- Examples of programming problems used in a contest
- An annual college-level contest that grows each year
- A look at some contest Internet sites
- The most important rule: FUN!

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